FINAL REPORT OF THE 1983 SEASON AT HEAD-SMASHED-IN BUFFALO JUMP ALBERTA

Jack Brink, Milt Wright
Bob Dawe, Doug Glaum

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by

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Bob Dawe, Doug Glaum

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February 1985 Edmonton, Alberta

ABSTRACT

This document constitutes the final report of archaeological activities during the 1983 field season by staff of Alberta Culture at Head-Smashed-In Buffalo Jump. The site has been identified by the Provincial Government for the development of an on-site public interpretive program which will include a 2400 m^2 interpretive building. One of the primary purposes in fielding a crew at HSI was to conduct archaeological studies of the site areas where development would cause surface disturbance. Such areas included parking lots, access roads, the building site and smaller related facilities. A second purpose in initiating a multi-year archaeological project at the site was to begin acquiring information about the site which is not available from previous studies and which is necessary to the interpretive program planned for the site.

A three month field season with a crew of ten addressed both of these objectives. Mitigative excavations determined that no conflict existed with the placement of the proposed building site. However, the originally proposed access road was found to traverse areas rich in archaeological materials. Revised road alignments were proposed and subsequently examined. This resulted in an acceptable alignment eventually being identified. Several alternate parking areas were also examined and conservation excavations designed to recover a sample of the cultural materials were undertaken. The cultural assemblage recovered from the parking areas below the cliff consisted primarily of a thin scatter of debitage and stone tools, fire-broken-rock, and bison bone. Several sub-surface pit features were encountered. These are believed to be cooking, boiling or roasting pits. The nature of the assemblage was such that continued excavation was not recommended, but the recovery of additional features was considered worthwhile and we recommend controlled surface stripping to expose other features in the parking and access road areas. This would be conducted in 1984. Additional mitigative studies will be required in 1984 due to changes in some of the development plans.

Other excavations conducted in 1983, not associated with the site development program included testing the camp/processing portion of the Head-Smashed-In site complex located on the rolling prairie below the

kill site. Tests here were widespread, consisting of single excavation units placed over a wide area in order to determine the nature and extent of the processing deposits. Recognizing the paucity of archaeological information on bison processing - as opposed to killing and initial butchering - it is anticipated that additional studies of the processing site will be conducted for years to come. The 1983 excavations were designed as fact-finding in nature. Results of these excavations indicated a dense, pavement-like deposit of cultural materials relating to secondary butchering and processing spread over an area of, at least, 0.5 km^2. Butchered bison bone, fire-broken-rock and lithic debitage and tools dominated the assemblage. Nearly all of our results indicate heavy use of the site in the Late Prehistoric Period, with only minimal evidence of earlier use. The pavement of cultural material lacked any stratigraphy and was contained entirely within the upper 25 cm of soil.

This report presents descriptions of all excavations conducted and analysis and interpretations of the results. Analysis is necessarily hampered by the nature of the 1983 field season. It combined mitigative excavations over a very large area, often in places lacking cultural remains, and research excavations also widely spaced and placed in areas of enormous richness but lacking stratigraphy. This report, then, attempts some preliminary statements about the nature of the data base pertaining to bison processing at HSI. It also reports on the status of the archaeological deposits situated in areas slated for site development.

ACKNOWLEDGEMENTS

A great many people contributed to the success of the 1983 field season. The fine efforts of an outstanding field crew composed (at various times) of Bob Dawe, Karie Hardie, Christopher Hughes, Rita Morningbull, Heather Nelson, John Priegert, Maureen Rollans, Loretta Rose, Tim Schowalter, Craig Shupe, Guy Trott, and Milt Wright were the greatest contribution. The Head-Smashed-In guides, Shauna Cunningham, Darren Massey, Susan Marshall, Lynne Tuk and Bryan Yellowhorn were valuable aids to us throughout the summer. We thank them and their supervisors, David McIntyre and Grant Tolley.

Many residents of Fort Macleod helped make our stay an enjoyable and productive one. We would especially like to thank Armin and Gerry Dyck of Coaldale who volunteered their services at the site on several occasions and treated us to the fine hospitality which they have been providing Plains archaeologists for several decades. Jim and Denise Calderwood kindly provided access to lands which contain much of the Head-Smashed-In complex. Jim Carpenter, John Dormaar and Terry Moore of the Lethbridge chapter of the Archaeological Society of Alberta took a keen interest in our project and organized a tour of the site for the chapter members. Richard Morlan of the Archaeological Survey of Canada spent several weeks with us and assisted us with the initiation of a test excavation of the spring channel. Dick subsequently undertook the analysis of the fauna recovered from the channel excavations. The analysis is included as an appendix to the report. We thank Dick for his interest and involvement with the project and for the good times on the porch. John Brumley of Ethos Consultants kindly allowed us access to his unpublished manual on bison butchering identification.

Many staff of the Archaeological Survey of Alberta have helped us in the field and in the lab. Tim Schowalter was a valuable colleague in helping with the faunal identification and in providing insight into overall strategies for faunal identification and coding. Bob Vance has continued to provide useful information on the vegetation and ecology of the site area and the region in general. Craig Shupe expedited us into and out of the field with his usual efficiency and class. John Priegert provided additional faunal expertise as well as field support.

Contributions to this report have come from Helen Clark who helped with the environmental setting section, Karie Hardie who authored the geological description of the site area, and Christopher Hughes who supplied us with information on the results of column sample analysis prepared for a university course. Dr. David Burley and Dr. Paul Donahue have given us and this project their encouragement and support and we appreciate their efforts.

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SECTION ONE

INTRODUCTION

INTRODUCTION AND REPORT ORGANIZATION

This document represents the final report of the 1983 season of archaeological studies conducted by staff of the Archaeological Survey of Alberta at the Head-Smashed-In Buffalo Jump site (DkPj-1) in southwestern Alberta (Figure 1). These investigations are part of the overall project by Alberta Culture to develop a public interpretation program at the site by 1986. The development program will include a 2400 m^2 interpretive building, full time staff, guided tours of the site, ongoing archaeological investigations and year round operation. Prior to the opening of the building several seasons of archaeological studies are planned. These studies have two purposes: (1) to investigate and mitigate any impact to archaeological resources at the site as might be occasioned by construction of the interpretive building facilities; (2) to promote research oriented studies of poorly understood aspects of the site and Plains prehistory in order to present a more comprehensive interpretation of the site to future visitors. The 1983 season necessarily focussed on the first of these objectives, but also initiated limited research oriented studies. This report will detail all work conducted in 1983, will present the results and analyses of our studies, and will suggest directions for future years' research and mitigation.

The 1983 investigations at Head-Smashed-In (HSI) involved a complex and extensive archaeological program. Many different kinds of studies were conducted covering a very large area and motivated by diverse objectives. In order to present the results of the 1983 season in a comprehensive and understandable fashion the report will be structured so as to first describe (in Section One) previous archaeological research at HSI, the environmental setting of the site, and the plans for public development of the site. Following this we will discuss separately the specific investigations conducted in association with the mitigation of development impacts, and studies associated with site research (Sections Two and Three). The detailed descriptions and analyses of cultural

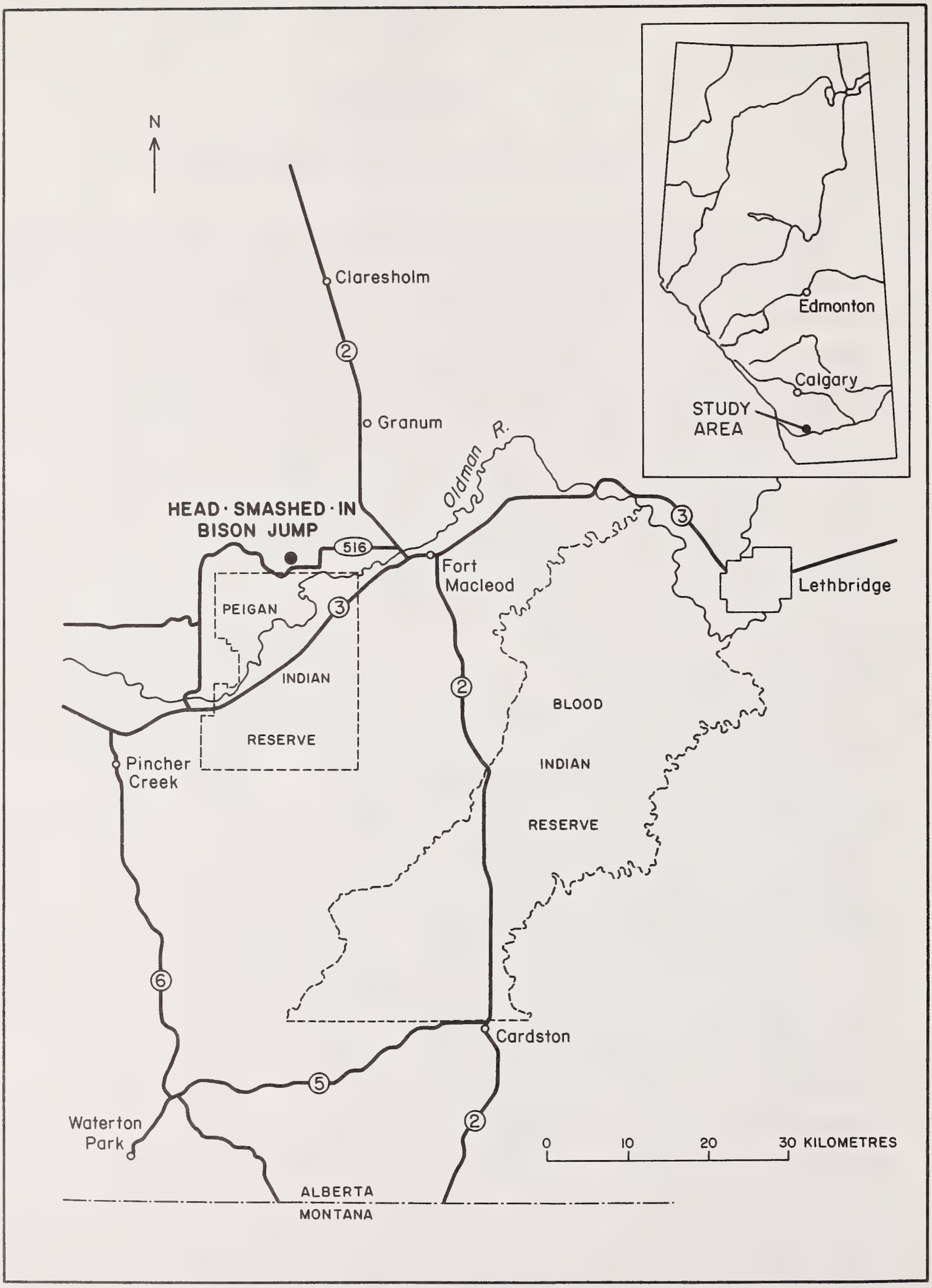

Figure 1: Study area and location of DkPj-1.

materials and features will then be presented in Section Four, this time combining data recovered from all areas of the site. This amalgamation of results was necessary in order to permit meaningful statements, as sample sizes from the numerous isolated and independent study areas were generally insufficient for analysis. After the analysis of cultural materials Section Five will present a discussion of our results, highlighting what we feel are the more significant conclusions and implications of our work. The report will then conclude with a discussion of objectives for future studies at HSI (Section Six).

PREVIOUS STUDIES

The history of archaeological studies at Head-Smashed-In is, itself, significant in that it was the first site excavated by a professional archaeologist in Alberta. This occurred in 1938 when Junius Bird of the American Museum of Natural History visited and briefly tested the site during his summer reconnaissance of Alberta and Saskatchewan. Some field notes and photographs of Bird's work are still available. Eleven years later one of western Canada's pioneer archaeologists, Boyd Wettlaufer, spent the better part of the 1949 field season conducting excavations in both the kill site bone bed and the prairie level butchering site. Field notes and artifacts of Wettlaufer's work have been located and obtained.

Aside from persistent looting by arrowhead collectors, the site lay dormant for 16 years until Richard Forbis of the Glenbow Institute assembled a project to excavate at Head-Smashed-In. Brian Reeves was appointed to direct the excavations in 1965 and he subsequently returned to continue this work in 1966 and briefly in 1972 (Reeves 1978, 1983b). No research was conducted at the site for another decade until Rod Vickers of the Archaeological Survey of Alberta returned in 1982 to conduct a brief test of a small area of the camp/processing site which was to be disturbed by placement of temporary interpretive trailers and a parking lot (Vickers 1983).

The location of Bird's excavation unit is not discernible from his field notes. We assume that he, like others to follow, focussed his excavation at the kill site below the cliff. The location of

Wettlaufer's excavations, both in the kill site deposits and in the processing area, are better known. This is due, in part, to a return visit to the site by Wettlaufer in 1983. We have not as yet attempted to precisely plot out and map Wettlaufer's excavation units but, because of the preservation of his datum mark on the cliff face above the kill, it should be possible to do so. Wettlaufer's study at HSI was his first direction of an archaeological project and was initiated while he was a student at the University of New Mexico.

The HSI excavation organized by Richard Forbis and directed by Brian Reeves produced the majority of our current knowledge of the archaeology of the site as presented in two published articles (Reeves 1978, 1983b). Reeves excavated several units of various sizes in the kill deposits, established the age of the site and identified the cultural and technological sequence represented in the 11 m of stratified deposits. Excavations placed on the prairie below the cliff were primarily directed by Ronald Getty, one of Reeves' crew members, and utilized a crew composed mainly of local volunteers. Again, several units of varying size were completed. However, little has been written about the results of this work and we have been unable to locate any of the notes kept by Getty and his crew. Reeves' interpretations concerning HSI have been based almost entirely on the bone bed excavations.

Collections from Reeves' excavations are split between the University of Calgary and the Archaeological Survey of Alberta (ASA); with lithics and other material culture at the former, and kill site fauna at the latter. Before the faunal material was submitted to the ASA, a separate faunal report analyzing the bison bones from the various cultural levels was written by staff of Lifeways of Canada Ltd. under contract to the ASA (Lifeways of Canada Ltd. 1979). To date we have not attempted to precisely relocate and map all the units excavated by Reeves. Two secure datums - one on the slump block near the cliff face and one on the prairie level at the processing site - are in place and should enable unit relocation.

In summary, Head-Smashed-In has been the most intensively examined buffalo jump in the province. Three separate professional excavations have been conducted over a span of 34 years (1938-1972). Two of these projects excavated both in the kill site and processing site deposits. The published papers and unpublished manuscripts which chronicle the work at HSI have based their interpretations on the stratified data recovered from the kill site. From this we have a picture of the cultural and technological history of site use through time. Previous research at HSI has provided little understanding of the processes and events associated with buffalo butchering and processing.

ENVIRONMENTAL SETTING OF HEAD-SMASHED-IN

Unlike most single archaeological sites, the Head-Smashed-In site complex, in its totality, covers an area of great size and environmental complexity. The total area for the site, from the gathering basin through the drive lane system to the jump off, kill and processing sites, encompasses an area of some 30 km^2. Within this region are found high and low hills and ridges of the Porcupine Hills, a broad valley bottom of Olsen Creek, narrow "finger" or tributary valleys which feed into Olsen Creek, sandstone bedrock escarpments, rolling prairie, a variety of soil and moisture conditions, and a wide array of vegetation patterns related to soil, moisture, slope, aspect, elevation and other environmental factors. As a result it is difficult to describe, in detail, the full environmental characteristics of the site complex. Instead we will present only a brief synopsis of the region.

Head-Smashed-In Buffalo Jump is situated in the extreme southeastern corner of the Porcupine Hills. Regionally the important bedrock units are the Willow Creek Strata which is overlain gradually and conformably by the Porcupine Hills Formation. These strata cap the Porcupine Hills region (Irish 1968). The Porcupine Hills Formation, which forms the jump escarpment, consists mainly of crossbedded non-marine sandstone with interbedded clay shales. A broad, shallow syncline is the major structural feature in the area.

South of the hills is the Old Man River which forms the major river drainage in the area. Larger streams in the local area associated with this drainage system are Olsen and Willow Creeks. The latter occupies a meltwater channel, a physiographic feature which stands as a reminder that at one time this region had been subjected to glacial activity. The Olsen Creek drainage basin lies to the west of the site and functioned as the gathering basin for the jump.

Evidence of multiple glaciation of the southwestern plains has been reported by a number of workers (Dawson 1896, Johnston and Wickenden 1931, Horberg 1952, Stalker 1956, 1958 and 1977). During the Quaternary, the study area was glaciated both by Cordilleran and Laurentide Ice. These two glacial events are responsible for the till veneer which is present in various parts of the study area. Much of the till mantle has been modified by later fluvial and lacustrine deposits.

Large glacial lakes formed by ponding of meltwater in front of the retreating ice. Lacustrine deposits in the area around Fort Macleod are attributed to a proglacial lake of late Wisconsin age. Alluvial deposits of Pleistocene age are extensive on both sides of the Oldman River. These represent a rather broad valley which existed before the Oldman was able to downcut into the underlying bedrock and establish its present river valley.

The erratics in front of the jump belong to what Stalker (1956) calls the glacial erratics train. These large rock masses have their source origin in the Athabasca River Valley near Jasper. A Cordilleran ice advance which carried the erratics was believed to have been deflected southward by a more eastward position of the Laurentide Ice Front. This mountain ice reached as far south as Montana.

A recent geological study of the HSI site area, contracted by the ASA, has suggested that the region may not have been glaciated in late Wisconsin times with the last glacial activity in the area dating to sometime before 50,000 years ago (Waters et. al. 1983). While this conjecture is only speculation at this time, it does seem to be in keeping with current beliefs of a number of Alberta glacial geologists (D. Proudfoot, N. Rutter, pers. comm.).

Recent geological deposits in the study area consist primarily of an extensive blanket of aeolian loess and, to a lesser extent, deposits laid down through alluvial or colluvial activities. Cultural materials at the kill and processing site area were contained in loess and slump deposits below the cliff and loess in the processing area. No till was observed in any of our 1983 excavations on the processing area and Reeves (pers.

comm.) says that no till was observed in his excavations of the bone bed or in the drag line trench excavated by the Geological Survey of Canada.

Soils at site proper, below the kill, are chernozemic. A thin Ah horizon extends from the surface to a depth of 10 cm. Below this lies a deep B horizon extending well over a metre in depth. For all practical purposes no C horizon was encountered in our excavations. The Ah horizon was dark brown in colour with a loamy texture and high silt and sand content. The B horizon was a buff coloured silty loess deposit generally stone free except for occasional sandstone fragments especially near the cliff and slump deposits. No paleosols or other evidence of a stabilized site surface were observed in our excavations into the B horizon. Rather, the B horizon appears as a massive loess deposit, apparently laid down fairly continuously throughout much of the Holocene. Disturbances extending into the B horizon included former gopher burrows, root and dessication cracks, and subsurface pit features. Variations on this generalized soil description occurred in certain areas of the site where local conditions, such as proximity to a steep slope, caused accumulations of much deeper organic horizons.

Summarizing the climate of the Head-Smashed-In site is not an easy task for the area involved coincides with the boundary of two major physiographic zones, the prairie grasslands and the flanks of the Rocky Mountain Foothills (Strong and Leggat 1981). This ecotone supports a variety of plant and animal life that is typically more abundant than either of the parent communities, and one which was no doubt exploited by the people using the buffalo jump. Although the western portion of the site complex is appreciably wetter and cooler, the main site area possesses a dry climate with an average of 40 cm of percipitation annually, over half of which is snow accumulation. The storm track of the area originates from the southwest where the strong Chinook winds can provide shifts of temperature in the range of 15 degrees (C) in only a few hours. The strong winds associated with this area can reach speeds in excess of 150 kph and a constant wind is the hallmark of the site. Temperatures in winter average -10°C and while the summer temperatures average +14°C, mid summer daytime temperatures often reach 25-35°C.

The region above and to the west of the jump is characterized as fescue grassland while that below and to the east is characterized as mixed prairie grassland (Bailey 1984). The plant communities of the site area reflect the varying amounts of available moisture and in descending order of moisture dependence these are: shrubland, deep fescue, shallow fescue, wheat grass-bromweed and wheatgrass-needlegrass. The shrubland species were likely of some importance to the prehistoric groups utilizing the jump site, providing abundant saskatoon (Amelanchier alnifolia), gooseberry (Ribes americanum), choke cherry (Prunus virginianas) and western snowberry (Symphoricarpos accidentalis). These regions of deep soil development and increased moisture content would have also provided a relatively precious resource of dry wood fuel which is essential for starting bison chip fires. The various grassland communities were of primary importance for the forage which they provided, and while the mixed grass species of the prairie flats would mature and dessicate in late summer, the fescue grasses of the gathering basin would remain standing moist and attractive to grazing ungulates.

Plains buffalo (Bison bison bison) were certainly the pre-eminent species of economic importance to the site inhabitants, but other species such as mule deer (Odocoileus hemoinus), pronghorn (Antilocapra americana), elk (Cervus elaphus), coyote (Canis lautrans) and ground squirrel (Spermophilus richardsonii) are common to the region and may have been exploited to varying degrees. Although well over thirty species of bird inhabit the area, several of which are raptors, it is debatable to what extent they were exploited by prehistoric peoples. Those readers wishing a more thorough review of the major animal and plant species are referred to one or more of the following texts (Mammals - Banfield 1974, Soper 1964; Birds - Salt 1976; Fishes - Scott and Crossman 1973; Plants - Moss 1983).

Specifically, the Head-Smashed-In kill site is formed by a vertical face of sandstone which today reaches a maximum height of 10 m (see Figure 2). This maximum height is attained directly above the channel of the natural spring which serves to wash sediment away, thus continuing the height of rock in this area. To both the north and south the height of the cliff face tapers off to only a few metres. To the north of the spring channel the cliff maintains a height of about 10 m for a distance of some 150 m before pinching out. To the south, the height of the cliff diminishes quickly, being reduced to a few metres within a distance of some 25 m.

Above the cliff the land rises gently for about 500 m before it crests and begins a long slope down to the Olsen Creek valley bottom. This area above the cliff is covered with sparse fescue grass with occasional brush in the local depressions which trap water. A few sandy blow-outs and exposures of sandstone bedrock also dot the hillside above the cliff. None of the drive lanes, or cairns, which presumably once led directly to the cliff edge are to be found in closed proximity to the jump-off. The closest cairns are now some 800 m away to both the northwest and southwest. Cairns once leading to the jump-off may have been removed to be used as rip rap in the irrigation works on the Oldman River (B. Reeves, pers. comm.), or they may simply be silted over from sediment dropped from the westerly winds after cresting over the hill top.

Directly below the jump-off are terraced accumulations of loess, sandstone bedrock spalls, bison bone, and other organic materials forming slump blocks (Figure 2). The slump blocks abut against the bedrock and pitch eastward at an angle of about 40^{o} over a vertical distance of approximately 60 m. The base of the slump blocks toe out in a gradual transition with rolling prairie. The slump deposits are covered with denser vegetation than the surrounding prairie, partly due to the influence of the spring, and in part to changes in slope and aspect. Several tall grass species co-occur with the short grasses. Chunks of bedrock topple break the surface of the ground in places.

At the toe of the slump block is the prairie level. The prairie slopes gently (5^{o}-10^{o}) to the east for a distance of about 2 km where it flattens out to an exceedingly level plain - probably a former glacial lake bed. Vegetation on the prairie is dominated by shallow fescue grass and other mixed grasses. Several small coulee or, spring, channels are etched on to the prairie, originating from either spring heads or natural seeps, or simply from places where rain run-off concentrates. The primary channel of interest is that formed by the spring at the base of

Figure 2: Aerial photograph of HSI site area and proposed development locations.

the kill site. This channel is approximately 10 m wide and 2 m deep, though exact measurements are difficult due to the gradual slope of the land. Water seldom flows in this channel. Spring snow melt and run-off from over the cliff face cause spring flow, but the channel is dry for most of the remainder of the year. This apparently has not been the case in the past, as local landowners and previous archaeologists attest to the more regular flow of the spring in the past decades (J. Calderwood, B. Wettlaufer, pers. comm.).

PROPOSED DEVELOPMENT OF HEAD-SMASHED-IN

The nomination of HSI to the United Nations Education Scientific and Cultural Organization World Heritage List in 1981 provided the leverage needed to put into operation plans for site development which had been informally considered for several years. Through channels in the Alberta Government the necessary applications were made for capital funding and manpower allocation and approval was received. A series of planning studies followed, as did the establishment of various teams of individuals identified to work on the project. By the summer of 1982 the basic approach, philosophy and physical components of the HSI site development program were identified.

The main physical feature of site development will be the on-site visitor reception centre (VRC). This will be a 2400 m^2 building designed to present the interpretive story of HSI to the site visitors. Display galleries, audio-visual productions, site tours, an ongoing archaeological program, and literature will be used to convey the pertinent information. After lengthy debate and evaluation of alternate locations for the building a site was selected which lies some 300 m to the southwest of the primary kill site (Figure 2). The building will straddle the cliff face and slump deposits to permit visitor access to both the upper and lower levels at the site. Of prime concern to this report is the fact that the building was to be excavated into cliff base deposits which had never been examined for archaeological materials. While it was our supposition that kill deposits would not be likely to extend this far from the known kill site (due to topographic factors which suggested the area was less suitable for buffalo jumping) this needed to be confirmed by field studies. By the time of our 1983 field season the location of the VRC was quite firmly placed and would only be moved if our archaeological assessment of that setting revealed a conflict with *in situ* cultural deposits.

Along with the VRC, development plans call for other major physical features on-site. The most important of these include the parking lot (or lots) to service the building and the access road from the existing highway (SR 516) to the parking lots and building. These development components were clearly more flexible than the building site, and have, in fact, changed considerably over the past year. Some of these changes came about as a result of archaeological conflicts: others reflected visual impact concerns, while still others have been produced through engineering or design parameters. As of this writing the precise location, size and shape of the parking lot(s) and access road are still not firmly fixed. However, our 1983 mitigation studies did examine several proposed locations for these developments at least some of which will no doubt eventually be utilized.

The parking facilities for the VRC have fluctuated in size from something suitable for 100 cars and 10 busses, to 45 cars and 8 busses. The very first architectural diagrams proposed a single large lot, but this was soon changed to several smaller lots and overflow parking areas. Figure 2 illustrates the proposed parking lot locations as of the time of our 1983 field investigations and Figure 3 illustrates the whole site area and the four sub-areas (1, 2, 11, 12) used to designate zones of archaeological testing. At this time a lot was proposed for Area 11 which would accommodate about two thirds of the required parking load. A second lot was identified to lie within the area designated Area 12 located further to the southwest of Area 11, and intended to fulfill the remainder of the parking requirements. Our 1983 mitigative studies were executed with these development plans in hand - plans which have since undergone significant alteration. If new or additional parking areas are identified they will be investigated as part of the 1984 field season at HSI.

The access road development plans have likewise undergone several revisions. The first change occurred after our brief test in May of 1983

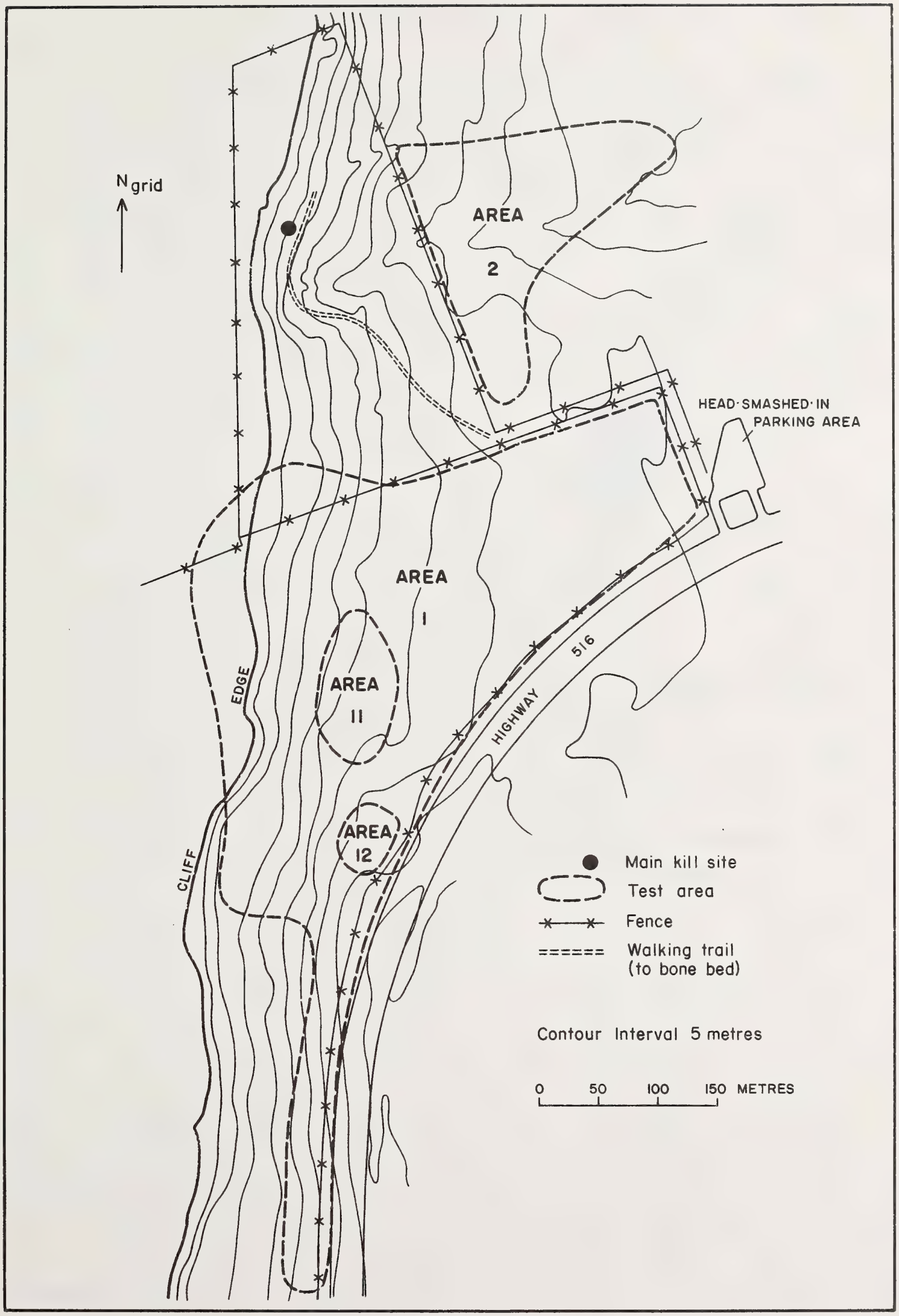

Figure 3: Site map showing mitigation area (Areas 1, 11, 12) and research area (Area 2).

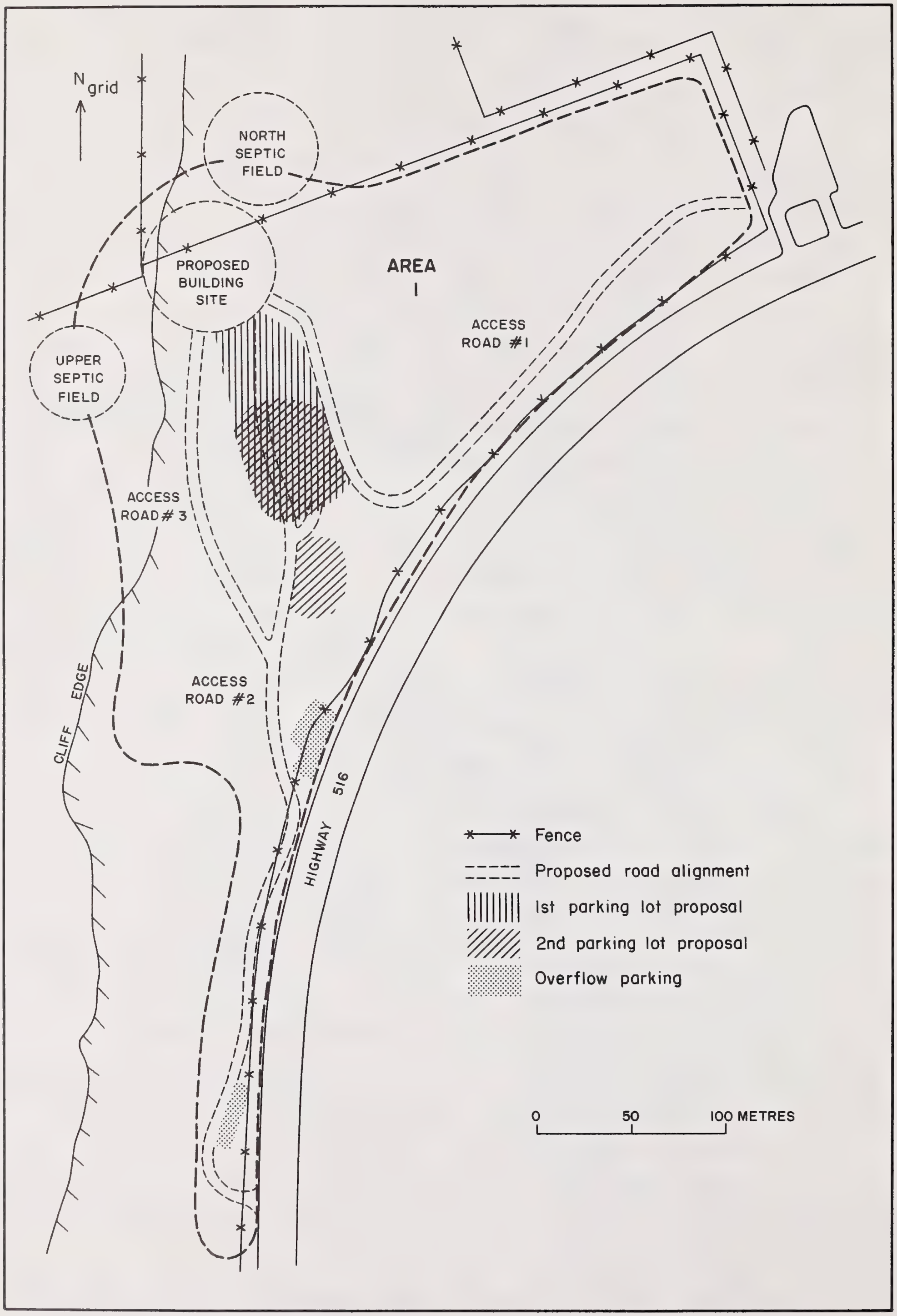

Figure 4: Map of proposed developments in Area 1.

when the first access road alignment was tested and found to contain a rich deposit of artifacts over virtually its entire length. This right of way proceeded from the existing parking lot adjacent to SR 516 in a westerly direction across the flat lands of Area 1 before rising slightly to the rolling land below the cliff and entering the main parking lot (Figures 2 and 4).

As a result of our tests this road alignment was abandoned and work was initiated to seek an alternate turnoff from the existing road. Eventually a second proposal for an access road was drafted, this time providing a turnoff located to the southwest of the building and parking lots and proceeding in a northeast direction over the sloping sides of the cliff escarpment (Figures 2 and 4). At the planning stage, our visual assessment of this alternate right of way (access road 2) suggested there would be minimal impact to archaeological materials and this was subsequently confirmed. As of this writing the precise access road alignment has not been completely finalized, although it is expected to change little from that illustrated in Figures 2 & 4 despite the uncertainty over the location of parking lots along this alignment. Thus, as currently proposed the right of way represents a linear disturbance some 600 m in length and 20 m in width.

All of the major developments discussed above will necessitate removal of the upper 10-15 cm of sod and soil in order to prepare a base for construction. In the case of the parking lots and access road the surface stripping will be followed by placement of gravel fill. This is due to the substantial downhill slope of the land surface from the proposed building site to the point where the access road first turns off of the existing highway. There is approximately a 25 m difference in elevation between the lower base of the building and the access turnoff point. Thus, our primary concern in investigating the access road and parking lots was to detect the presence or absence of near surface cultural deposits which would be destroyed in facility construction. Cultural deposits buried deeper than about 25 cm in these facility areas would likely be buried under fill and as such would not suffer direct impact but would be made inaccessible for further study. Our assessment program generally involved testing to a depth of .5 - 1.0 m below surface with the exception of backhoe trenches which were excavated to depths in excess of 3 m.

In contrast, the building site will be disturbed by a very deep excavation necessitated by the burial of the majority of the building underground. Excavations in the order of 20 m from the top of the cliff slope will be necessary before construction of the building foundation. Reflecting this impact our hand excavated units and backhoe trenches at the proposed building site were excavated to about 4 m below surface. Clearly, testing to the full depth of the proposed building excavation would have been impossible with equipment available to us. Instead we have proposed that the building foundation excavation, planned for the fall of 1984 - be monitored by archaeological staff to examine for deeply buried cultural materials.

Finally, the HSI development program will necessitate a number of smaller site impacts. These will include drilling a water well and laying water pipe from the well to the building; placement of a septic field; laying gas and electrical cables to the building; and eventually landscaping the building and parking areas and construction of walking trails around the site. At the time of our 1983 field work no detailed plans for any of these developments were available. However, the architect and his sub-consultants did suggest several alternate septic field locations. One proposal was to place the field in the heavy brush just to the north of the building site about halfway down the slump blocks. An alternate septic location was to place the field above the cliff on top of the sandstone escarpment (Figure 2). Although we had no precise schematics for either of these alternatives, through discussion with the architect it was possible to place their approximate location. We, therefore, conducted tests of the two proposed septic field locations.

The next two sections of the report will discuss the results of our excavations in the development and research areas at HSI. Within these sections we will report on the methodology of our studies, the placement and amount of excavation conducted, and a general description of the results. Detailed descriptions and discussion of recovered materials (including lithics, features, fauna, ceramics, etc.) are presented separately in Section Four.

SECTION TWO

1983 EXCAVATIONS AT DkPj-1: DEVELOPMENT AREA

INTRODUCTION

This section provides the results of the archaeological investigations conducted in the development area of the Head-Smashed-In Buffalo Jump. The excavations described in this section were designed to mitigate the construction of a Visitor Reception Centre and attendant facilities which are to be installed on the site over the course of the next three years. The development area was designated as Area 1 and is located south of the main kill site and prairie level camp/processing area (Figure 3). Within Area 1 were located the building site, access road alignments and two parking lot facilities, the latter being designated as development Areas 11 and 12. Although the location of the development area was designed to minimize impact on heritage resources at HSI a variety of subsurface testing programs were undertaken to determine the acceptability of site specific developments. As a consequence of the subsurface evaluations several of the initially proposed development sites were changed to lessen the impact to heritage resources.

The discussion of the excavation results is prefaced by a review of the methodologies employed during the subsurface testing programs conducted in May/83 and during the period June - September/83. Alterations in the location and size of site facilities following the May/83 test excavations necessitated the reevalutation of some test areas during the summer. In some cases the further testing of specific development areas was needed to assess the veracity of our earlier test excavation results and the suitability of the methodologies employed. For example, it was found that the auger test results of May/83 yielded insufficient detail for purposes of delimiting acceptable parking lot boundaries and these data were augmented by shovel test evaluations of the same area during the summer excavations.

The adoption of a particular test excavation methodology is predicated on several factors including the nature of the development, crew size, time constraints, size of area to be tested, the composition of the subsoil matrix and the kinds of archaeological remains anticipated. The discussion of individual test excavation methodologies presented below are modal descriptions and some deviations from these procedures did occur. In most instances such changes did not represent a significant alteration of the methodology, but rather an adjustment to accommodate site specified concerns. Any adjustments to the standard methodological approaches are detailed in the body of the report.

METHODOLOGY

Prior to the initiation of test excavations the various locations of specific developments such as the building site and access roads were flagged in the field with the aid of architect's schematic drawings. Once the general parameters of the development were outlined specific baselines were established which would then be used to tie in the subsequent test excavation programs. The baselines were shot in with a transit and the bearings recorded relative to magnetic north. Later these same baselines were tied to construction blueprints so that sensitive archaeological deposits could be accurately demarcated and avoided during the construction phase. Major intervals along the baselines were marked by wooden stakes driven deeply into the ground to avoid displacement by grazing ungulates. All test excavation units were measured from the baseline using either the transit or tapes and compass readings. Auxillary baselines were added as required during the expansion of the test excavation programs.

Auger Testing N=62

A portable power auger was employed during the initial field excavations in May/83. Once a pattern for placement of the test holes was transferred to the ground a single section of auger drill measuring 25 cm in diameter and 1 m in length was positioned over the test location. During the course of the auger's downward progress record was made of the materials being recovered from the expelled sediment and an approximate depth was noted. The sediments were passed through 1/4" (6.3mm) mesh and the materials were retained and catalogued. The only exception to this procedure involved the fire-broken-rock which was simply counted and discarded. The augering would continue until it was apparent that sterile sediments had been reached or until soil compaction prevented further augering. In some cases it was necessary to utilize both sections of the auger thus yielding a 2 m deep hole to test for deeply buried components, while in other cases extremely hard, compact soil prevented augering below 50 cm. The power auger was useful for noting the presence of material culture remains but it provided only a very narrow exposure of the buried remains and depth measures for these materials are necessarily conjectural.

Shovel Testing N=145

All of the shovel test excavations were conducted between June and September 1983. The position of the test units was flagged and the southwest corner of the test hole was placed coincident with the flagging pin. The shovel tests were informally laid out as 50 cm^2 holes. The sod cover was usually stripped off in one or two pieces and the clods broken apart with a trowel and visually inspected for artifactual remains. The excavation would then proceed in 10 cm intervals, the matrix being shovelled into buckets and then transferred to a hand screen (1/4", 6.3 mm mesh). Materials recovered were bagged according to the level and by class (ie. bone, lithic, FBR) with field notes describing the matrices encountered. All shovel test holes were excavated to sterile levels, or where hardpan deposits or depth of the test hole made it physically impossible to continue digging. Generally, these test holes could not be excavated beyond 60 cm in depth. The final depth of the test unit was recorded and a simple sketch profile was drawn of one of the shovel test walls. While the shovel tests were more time consuming than the auger holes, the trade off in time was well repaid in the enhanced levels of data recorded.

Backhoe Tests N=6

In order to detect deeply buried material remains several backhoe trenches were dug near the building site and in the parking area. The deep sedimentary profile of these trenches was recorded in order to clarify local site depositional histories. Trench excavation was closely monitored and when remains were noted in the trench or the spoil pile digging was discontinued until notes could be made on the kinds of remains recovered and their approximate position within the trench. All large identifiable portions of bone were recovered and catalogued. Trenches were dug to sterile levels or until sandstone blocks and impermeable bedrock levels were encountered. The trenches averaged about 4 m long, 3 m in depth and were just under 1 m in width. The six trenches were numbered sequentially as they were excavated.

Excavation Units N=24

The standard excavation unit employed during the test evaluations of Areas 1, 11 and 12 was the 2 m^2 of which 18 were excavated. Variations on this standard approach were employed in response to site specific needs and included the use of one 2 x 1 m square and five 1 m^2 units. The discussion below details the normal excavation methods employed during the 1983 field season. In some instances the methodology was modified to accommodate site specific concerns. Details regarding any alterations to the standard methodology are noted in the discussion of results for each excavation area and the rationale for those deviations are presented.

Test excavation units were established with reference to one of the baselines, and the four corners were demarcated with wooden stakes. The 2 m square was divided into two constituent parts, quadrants and subquadrants. The quads measured 1 m^2 and were given alphabetic designations A, B, C, and D beginning in the southwest corner of the excavation unit. The 1 m^2 quads were then divided into four equal portions designated as subquads measuring 50 cm on a side. These were designated 1, 2, 3, and 4 beginning again in the southwest corner of the quadrant (Figure 5). For reasons currently unbeknownst to any of us the brief tests conducted in May began the quad and subquad labelling system in the southeast corner instead of the southwest.

The sod cover from each subquadrant of the excavation units was removed with a combination of spade and trowel dependent upon the density of the mat. The sod was placed in 1/4" (6.3 mm) mesh hand screens and

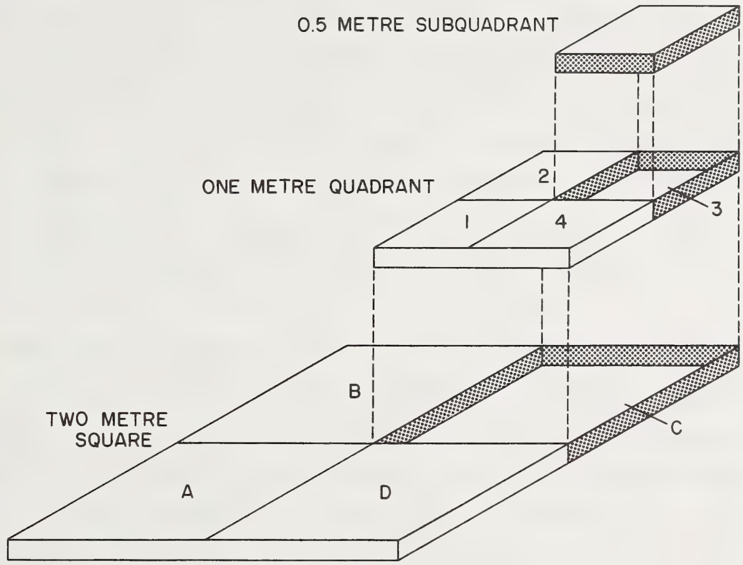

Figure 5: Illustration of provenience recording methodology.

broken apart to determine the presence of artifactual remains. Excavation would then proceed using trowels until the first arbitrary level was reached at 10 cm below surface. This marked the completion of the first level of the initial subquad following which notes would be made regarding the matrix and any finds and the recovered materials were bagged and labelled. The excavation would then proceed to an adjacent subquad and a similar procedure followed until all subquads of the quadrant were completed. Concentrations of FBR and large mammal bone portions were mapped in situ at the completion of each arbitrary level. Some units were so densely layered with FBR and bone that several floor plans had to be drawn and photographed in the course of excavating a single level. Excavation would proceed in the stepwise manner outlined above until the unit ceased to produce artifactual remains. Lithics, bone and FBR were bagged separately; fragile bone pieces being wrapped in foil and sometimes treated with diluted white glue to prevent further disintegration. Carbon samples were placed in foil to prevent contamination. In order to ensure that sterile substrate had been reached one quadrant in each 2 m^2 was selected for further excavation. This usually involved the use of a pick and shovel to penetrate the consolidated subsoil matrix to a depth of approximately 1 m. If no further materials were encountered the wall of the quadrant with the greatest depth was profiled and photographed. Notes were made regarding the nature of the sediments forming the profile, the soil horizons present and the Munsell colour code for those horizons. The final step prior to backfilling the unit involved the removal of a column sample from the south wall of the southwest corner of the excavation unit. The column measured 50 cm on a side and was removed in 10 cm levels, bagged and transported to the base camp for processing with a flotation device (Watson 1976). The procedure utilized in the processing of flotation samples is outlined below.

The recording of artifact provenience was to the 50 cm^2 subquadrant and 10 cm excavation level; no exact provenience measures were taken. However, the floor plans drawn of the rich layers of bone and FBR excavated in Area 2 provide an accurate record of the location of these materials. Another exception to the 50 cm^2 subquad method of recording provenience occurred when features were encountered. Features included discrete concentrations of FBR and bone, hearth stains and subsoil pit features containing abundant FBR and bone. The features were photographed and drawn in plan form and artifactual remains were bagged separately from the adjacent subquad. In order to ascertain the morphology of the feature a cross section profile was excavated coincident with the long axis of the feature. This profile was also drawn and photographed. A matrix sample was obtained from the feature for subsequent processing with the flotation device. Fire-broken-rock was, in all instances, counted and weighed and then discarded.

Flotation Processing

The flotation device employed during the 1983 field season conforms to the standard model employed by Watson (1976) and has been utilized at other bison jump site excavations in Alberta (Wright & Ball 1983). Briefly the unit consists of a standard 45 gallon oil drum with the top removed, a sediment baffle and drain plug installed in the base, an interior frame to support the insert basket lined with fine mesh, and an overflow spout to direct the float fraction into nested geological screens suspended from the side of the unit. The barrel was supplied with fresh water from the Belly River by a portable gas pump. After filling the barrel with water, a sediment sample from either a column or a feature was poured into the insert basket. An attempt was made to break down large lumps of earth during the process of pouring the sample as this greatly diminished the time and effort required to break down these clods by agitating the sample slurry. Increasing the flow of water to the barrel caused the float fraction to overflow into the nested geological seives (3.35 mm, 2.0 mm, .85 mm). Both the float samples from the geological seives and the heavy fraction retained in the 2 mm mesh inside the barrel were transferred to the lab for drying and sorting. The barrel would require emptying of the sediment trap every fourth or fifth sample and the water obtained from the Belly River was sampled to determine the character of any intrusive organic remains. Over sixty samples were processed during the course of the summer involving over 700 kg of sediment.

RESULTS OF EXCAVATION AND ASSESSMENT OF DEVELOPMENT AREAS

INTRODUCTION

Prior to the initiation of archaeological test excavations in May 1983, the only map coverage available delineating the locations of the proposed development facilities was an architect's schematic drawing. This was a rough draft, not a blueprint, of approximate locations for the building, parking lots and access road. No surveying or staking of development areas occurred during the 1983 season. Hence our investigation of these areas was based on the best available information and often involved on-site meetings with the architect, his subcontractors and various individuals involved in the planning process. Often these meetings resulted in on-ground changes to the initial schematic site plan, sometimes because of architectural concerns, other times because of unacceptable archaeological impacts. Also these development plan changes often necessitated multiple archaeological testing of the same development areas. It is worth noting that none of the development plans for HSI have received final management approval from Alberta Culture and may still be subject to change.

In order to simplify the presentation of the data results each specific development proposal is dealt with in turn so that test results are specified for both the initial and the amended development proposals. In some instances the amended location of a development project bore no resemblance to the site initially proposed, while others involved only minor shifts in location.

ACCESS ROAD ALIGNMENTS

Two access road proposals were evaluated during the 1983 test excavations; the second alignment being considered after the first was found to present unacceptable levels of impact to heritage resources. The relationship of the two alignments is presented in Figures 2 and 4. Although much of the disturbance from road construction would only impact the near surface deposits, it was soon apparent that this coincided with the majority of the archaeological deposits at Head-Smashed-In.

Access Road One

This access road proposal was evaluated during the May 1983 testing program and was ultimately judged to be unacceptable as a consequence of site disturbance factors and visual impact to the overall site setting.

The road turn in originated in the current parking area for the Historic Site Services trailers and ran southwest roughly paralleling the alignment of Secondary Road 516 for a distance of approximately .25 km, the road then swung to the north terminating in a large parking area. The eastern half of the right of way crosses nearly level ground; the western half traverses the rolling deposits which have accumulated near the base of the cliff (Figures 2 and 4). The centre line of the road was estimated with the aid of schematic architectural drawings and flagged. A baseline measuring 230 m in length was sighted along the alignment using transit and surveyor's chain preparatory to subsurface testing. An auger program was conducted at 20 m intervals along the road consisting in total of 12 test holes. The results of the testing are displayed in Figure 6, where it is noted that only one test proved to be sterile. The remaining auger tests provided evidence of heritage resources in the form of FBR, bone and lithic artifacts. All tests were taken to a depth of approximately 90 cm except for the test nearest the turn in area. This unit was abandoned after reaching a depth of 20 cm due to our unwillingness to further disturb a dense deposit of fire- broken-rock, bone and lithic materials. It was clear from the results of the testing program that the archaeological deposits became richer proceeding from west to east, that is, from sloping ground to nearly level ground. In all cases the materials were restricted to the upper 25 cm of the site deposits.

The auger testing program results were augmented by three 1 m^2 test squares; two were placed at either end of the alignment and the third was located midway along the alignment (Figure 6). Unit 8 at the western end of the road contained a dense deposit of artifactual remains in the upper 10 cm but relatively few remains below this level. The exception to this was the remains of a feature encountered in the first level and extending to 30 cm below surface. The structure of the feature and its contents suggest this may have been a hearth feature that was subsequently

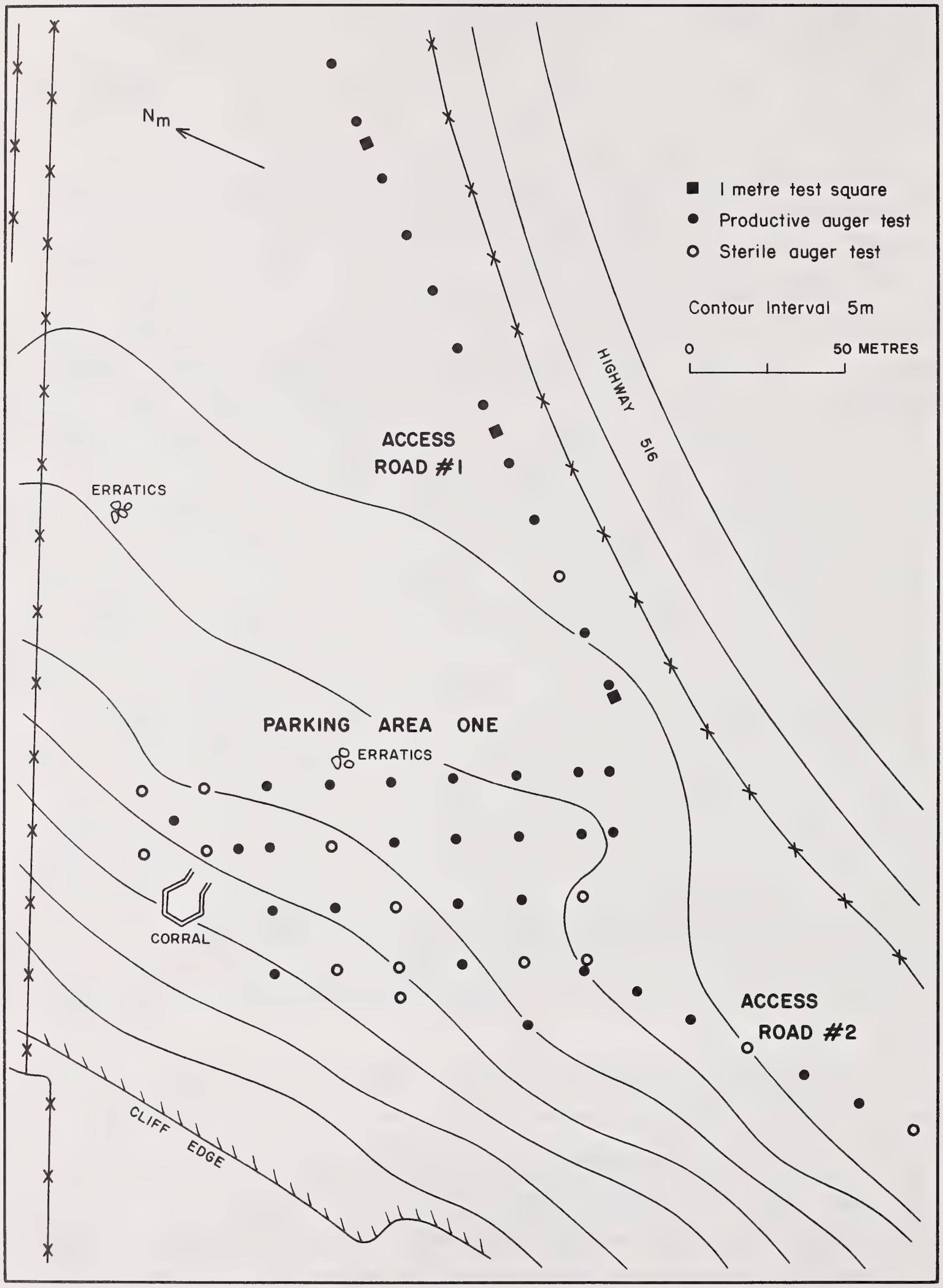

Figure 6: Auger testing in development area.

infilled with refuse. Although a point base recovered from the feature was suggestive of an Early Prehistoric age (see Figure 42b and 65), a radiocarbon assay of bone from the deposit produced a modern date (BETA-7791). A substantial amount of rodent disturbance detected in the upper 20 cm of the unit may have resulted in the downward movement of modern materials to lower levels. The majority of the bone fragments recovered were attributable to bison, with identifiable units being restricted to the more robust lower limb bone elements (Table 1). A total of 90 pieces of FBR was recovered, mostly from the upper 10 cm of the deposit (Table 19).

The density and character of the material remains recovered from this unit and the presence of a feature suggest an extensive occupation of this particular area of the site. No structural remains were noted in this small unit, but nearby on the level ground to the east we noted one well preserved tipi ring and several possible rings.

Unit 9 was located midway along the access road and proved to be the richest of the three 1 m test squares. The upper 10 cm of this unit contained the majority of the material remains, and by a depth of 20 cm the unit was sterile. Rodent disturbance of the upper 20 cm was clearly indicated and preservation of bone was markedly better in the lowest levels of the unit. As noted in the case of Unit 8, Unit 9 yielded primarily the lower limb bones of bison. The amount of fire- broken-rock recovered was notably different from the previous unit with over 260 pieces recorded, although the average size of each piece was somewhat smaller (see Table 19). There was no definite configuration or feature evident and the unit is thought to represent an accumulation of surface remains from repeated use of the area.

Unit 10 was located at the eastern end of the road alignment. Although auger tests indicated dense material cultural deposits in this area, the unit produced relatively few artifacts. The count of FBR continued to be high but there were few lithic items recovered and the bone fragments tended to be small and very friable. No remains were excavated below a depth of 20 cm and no features were discovered.

The results of the auger tests and 1 m^2 excavations indicated a rich archaeological deposit in the upper 20 cm of the soil along

Table 1: Bison elements recovered from area 1 excavation units.

Bison Elements

Excavation Units	Head	Hyoid	Cervical Vertebra	Thoracic Vertebra	Lumbar Vertebra	Sacrum	Caudal Vertebra	Ribs & Sternebra	Pelvis	Scapula	Humerus	Radius/Ulna	Carpals	Metacarpal	Femur	Patella	Tibia	Tarsals	Metatarsal	Metapodial	Foot	N
1					1			4	2			1	1						2	3	4	18
2	1							2		1					1		1		1			7
3													3					1				4
4					1			1			1				1							4
5				1																		1
6			1					1		2									2	1	1	9
7													1									1
8																	1	1		2	1	5
9									1			3	3	1			1	5	2		1	17
10																						-
N	1	-	1	1	2	-	-	8	3	3	1	4	8	1	3	-	3	7	7	6	7	66

virtually all of the first proposal for an access road. An area of about 2500 m^2 would be disturbed by road construction. It was determined that salvage excavation of this deposit was not practical and that a more acceptable course of action was to relocate the road. In addition to the archaeological impact there were a number of factors related to site aesthetics that argued in favour of a relocation of this development.

Access Road Two

The second road alignment was the result of joint input by architects, engineers and archaeological staff. Although the proposal lengthened the road by a factor of two, the areas traversed were judged to be archaeologically less sensitive, and also more aesthetically appealing than the original alignment. Subsequent archaeological assessment confirmed our suspicions regarding low amounts of cultural material. As of this writing it appears that an alignment very similar to that illustrated in Figures 2 and 4 will be approved.

The second proposal for an access road turns in from Secondary Road 516 approximately .6 km south of the proposed building site for the VRC (Figures 4 and 7). For part of its length the roadbed will be located on formerly disturbed right of way and no archaeological assessment was warranted. The remainder (about half) of the alignment crosses unbroken prairie which flanks the slump deposits at the base of the sandstone escarpment (Figure 8). The presence of heritage resources was assessed with a combination of auger testing, shovel testing and backhoe excavation. Baselines were established at either end of the road alignment to guide the auger and shovel test programs. The backhoe excavations were conducted subsequent to the auger and shovel tests by an engineering firm and were not tied to the site datum except by sketch maps.

The turn in area at the southwest end of the second access road was assessed with 10 shovel test units spaced 20 m apart, except for two which were placed 10 m apart (Figure 9). All of the units were excavated to approximately 50 cm below surface and 70% of the units were sterile. The remaining three units contained small quantities of fragmentary bone, none of which in itself could be taken as direct evidence of prehistoric occupation of the area. We noted the occurrence of bone and some FBR to

Figure 7: Turn in location of access road two from SR 516.

Figure 8: Test excavation of access road two alignment.

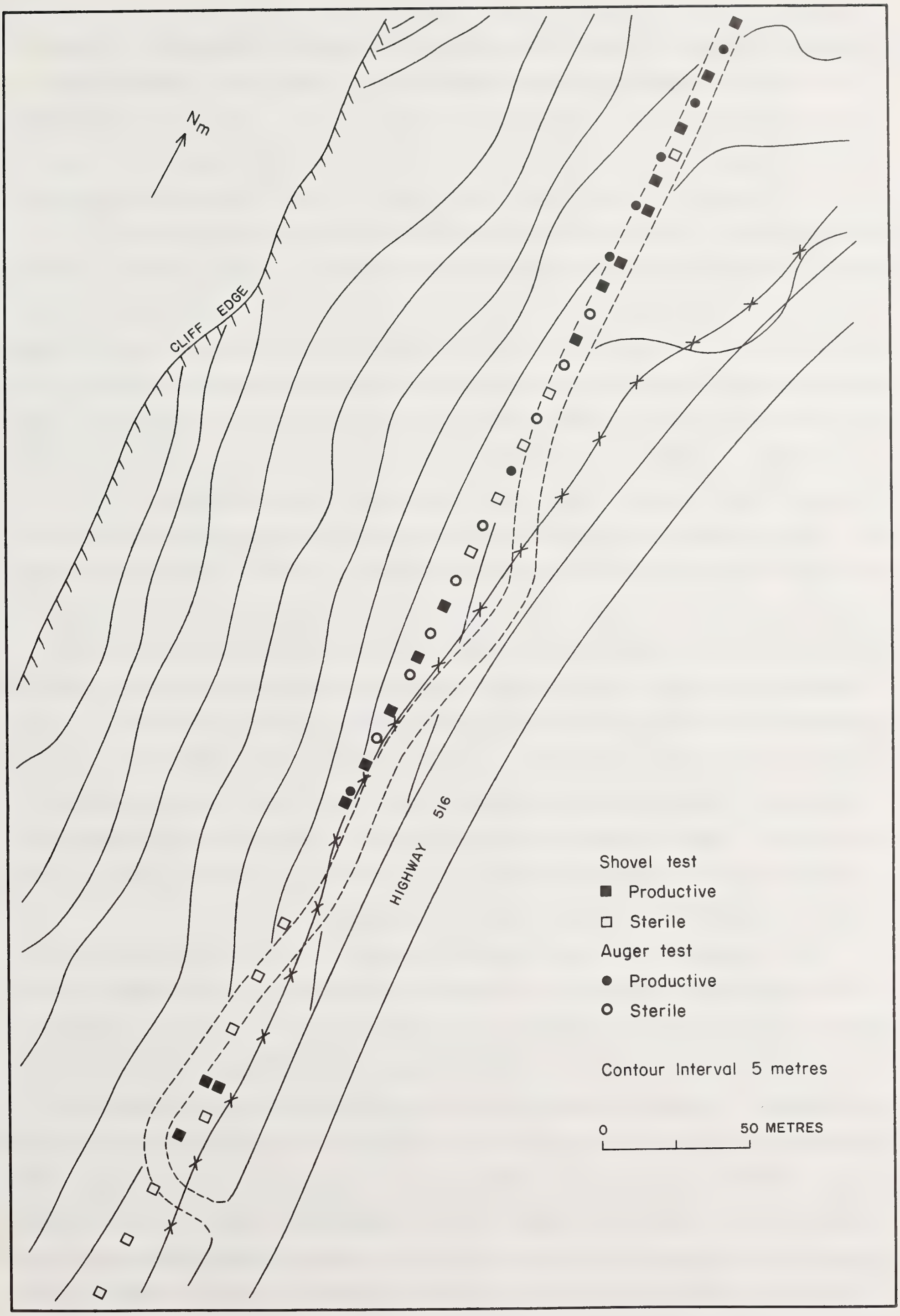

Figure 9: Results of testing access road 2.

the east of the test area in the road cut for SR 516, but it appears that most of this deposit was associated with a small encampment situated on a level strip of land which was removed when the highway was upgraded several years earlier. The backhoe testing was completed in the fall of 1983 and was designed to facilitate engineering assessment of the local fill for purposes of building the roadbed. The parking area is going to be subject to extensive downcutting and the backhoe offered an opportunity to discover deeply buried deposits. The backhoe tests were 3 m deep and did not reveal deposits beyond 40 cm below surface. The materials recovered were all bison bone some of which were large complete elements including the skull and post cranial portions. At this point in time it is impossible to characterize the nature of these finds. They may simply be natural kills but monitoring of road construction later this year may clarify the context of these faunal remains.

The northern portion of the road alignment was tested with a combination of 15 auger tests and 28 shovel tests. The excavations were spaced equidistant from one another to facilitate test locations at 10 m intervals along the 310 m baseline in alternating sequence (Figure 9). The auger test results indicated that few remains were present along the majority of the alignment, particularly the southern portion. A total of eight of the auger tests proved to be sterile; the remainder revealed some bone fragments and in two instances some lithic debitage was recovered. Shovel test excavation results essentially confirmed the findings of the auger tests with several of those units located in the southern portion of the alignment proving sterile.

The results of the two testing programs promoted the acceptance of this second road alignment proposal as having a very low impact on heritage resources. In our opinion the paucity of cultural remains along the second access road is a direct result of the topographic character of the region. This alignment skirts the side of the slump deposits alongside the sandstone escarpment resulting in a fairly steep slope over much of the right of way. Tests of these sloping areas, primarily the southern end of the road, were almost invariably negative or yielded materials which may be natural. As the ground approached a more level orientation tests tended to be more productive. In our opinion no further archaeological excavation is required for the access road, however the initial blading of the road should be monitored. It may be that small occupation areas were missed, or that additional features such as those discovered in the parking lot areas (see below) will be encountered.

Access Road Three

In addition to the latter road alignments a possible access route was proposed running along the upper bench of the development area. Although subsequently abandoned because of engineering problems, the alignment was tested by our crew using 17 shovel tests and two backhoe test trenches. This third possible access route essentially parallels the second route, originating at the same turn in point off of SR 516 and proceeding in a northwest direction before swinging north towards the VRC. However, unlike the second route which occupied the ditch area alongside the existing road, the third route climbed upslope and proceeded north along a minor bedrock bench which is about halfway down between the cliff top and the prairie level (Figure 2).

The shovel tests were relatively shallow, owing to the near surface bedrock outcrops, and of test holes excavated just under 50% proved to be sterile. The remaining tests yielded few materials and suggested that minimal disturbance to heritage resources would be occasioned by the road alignment. The backhoe trenches were completed, one midway along the road alignment and the other at the northern termination. The first trench reached bedrock at a depth of 2.5 m and produced bone elements from near surface to 1.6 m below surface. The bone elements did not occur in concentrations and tended to be scattered throughout the profile. No artifacts or other evidence of cultural occupation were encountered. No paleosols were evident in the profile and this, coupled with the sandstone fragments noted throughout the matrix, suggests a relatively continuous and rapid accumulation of sediments. The second trench was oriented parallel to the cliff face running for a distance of 4.5 m and averaging just over 2 m in depth. This trench produced several bone elements at varying depths up to 1.2 m below surface. In addition to bison several canid bones were recovered and suggest that the deposit in this area may be more a consequence of scavenging activities than cultural agencies. The only cultural materials noted were a few pieces of FBR in association with a small hearth stain feature 50 cm below surface (see Figure 67). The small dish-shaped hearth contained burned and unburned bone, FBR and measured 37 cm in length and 4 cm in thickness. The plan form and dimensions of the hearth feature could not be determined and insufficient materials were recovered to undertake radiometric dating. It is noteworthy that of all the various tests conducted in the deposits located just below the top of the sandstone escarpment (this includes shovel tests, backhoe trenches, and 2 m^2 excavations) this feature was the only definite evidence of cultural occupation. In other words, once one leaves the rolling prairie level below and proceeds up the fairly steep slope of the slump block deposits, the archaeological record is one entirely composed of bone. The bone is primarily bison and, because of the relatively rapid sedimentation occurring below the cliff face, the bone can be quite deeply buried. However, in all excavations in the slump block deposits the bones were recovered in almost random fashion. There was little or no evidence of association, concentration, activity patterning, and no other artifactual material. This had led us to believe that the bone from these slump block excavations is primarily scavenged or otherwise transported from the main kill located to the north. This point will be discussed further below. The one small hearth feature encountered in our backhoe trench profile is testimony that at some time the human occupants of the site did conduct activities on these slump deposits, but our results suggest that such events were rare.

PARKING AREA PROPOSALS

As discussed above, parking facilities originally proposed for the VRC were designed to accommodate 100 cars and 10 recreational vehicles or busses, with further provision for some overflow parking. The development area for the main parking lot covered a large area measuring 150 by 100 m, representing the single most substantial impact to the site area (see Figures 2 and 4). Owing to the ongoing changes in the road alignment and revisions to the parking requirements, several other proposed parking areas were evaluated and the results are discussed below.

Parking Area One - Initial Proposal

The boundaries of this large parking area were estimated with the aid of architects' schematic drawings and flagged in the field. The original proposal was assessed using an auger test program consisting of 34 test holes in a 20 m^2 grid pattern (Figure 10) and five excavation units of varying sizes (Figure 11, Area 1 Units 3-7). Several tests were conducted outside the grid network to accommodate local topographic constraints and site specific anomalies. Just over 1/3 (35%) of the auger tests encountered sterile deposits and 14% contained only bone fragments. The remaining tests contained a combination of bone, FBR or lithic remains as noted in Figure 10. The most productive units were located along the eastern periphery of the parking facility which is also the most level ground of the development area. The trend became established during the course of continued testing that the more nearly level the ground surface, the greater the potential for heritage resources. It is notable that even a change in slope of a few degrees would significantly diminish the concentration of material remains. The results of the auger test program indicated that construction of the parking lot would disturb significant site deposits in certain specific areas if development plans were not modified.

In order to evaluate the nature of the archaeological deposits in more detail a series of excavation units were completed within the parking lot development, including two 2 m^2 units, one 1 x 2 m unit and two 1 m^2 units. The five excavation units were placed judgementally within the boundaries of the parking area (Figure 11, Area 1 Units 3-7). All of the test units revealed material culture remains but there was great variability in the number of items recovered between different units. By and large, the majority of the artifactual remains were found in the upper 10 cm of the site deposit and no obvious features were encountered. The lithic remains recovered consisted mostly of small debitage fragments with few recognizable tool portions.

Bone preservation was poor and all of the elements identified were from the post cranial skeleton, notably limb element fragments (Table 1). Some activity patterning was indicated by the relative abundance of FBR in some units but no discrete features or activity events were identifiable.

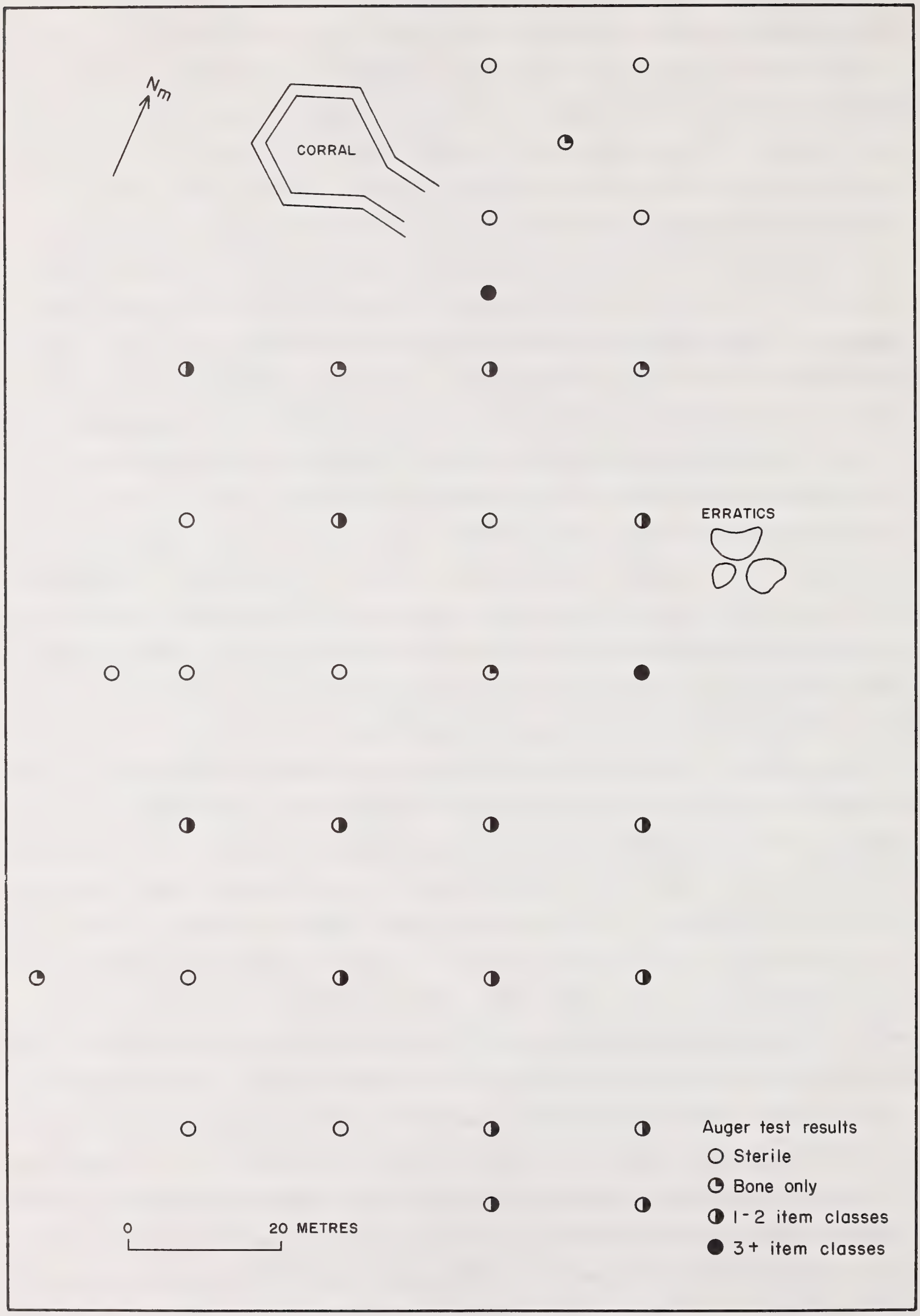

Figure 10: Results of auger tests in first main parking lot.

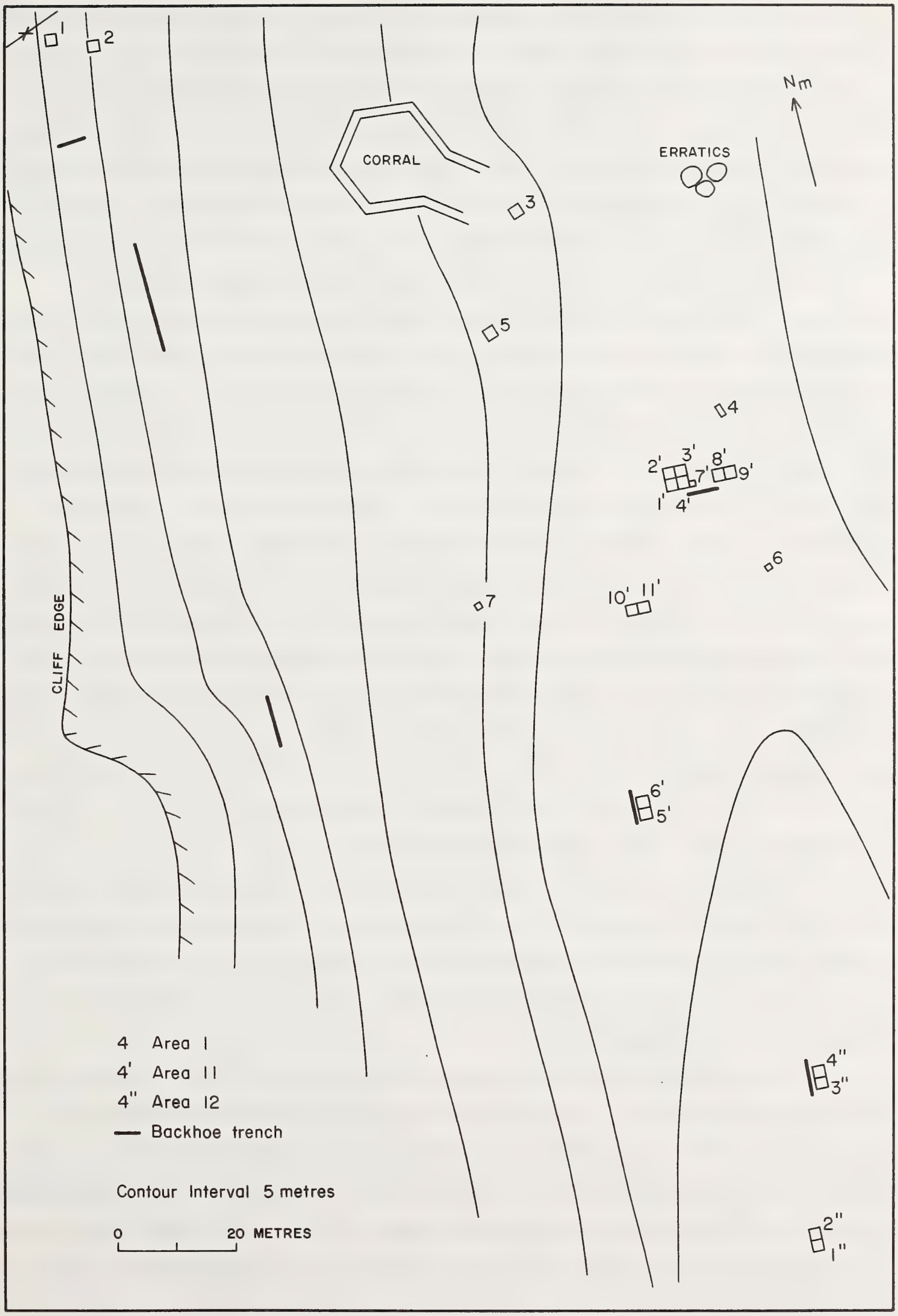

Figure 11: Excavation units in Areas 1, 11 and 12.

The nature of the archaeological remains recovered, and the relative abundance of the various classes of materials identified suggest that the parking area was the scene of periodic encampments peripheral to the main processing areas. No substantial time depth is indicated by the types of material remains recovered from these units and although some artifacts were recovered at depths below 50 cm it is most likely that rodent disturbance has promoted the downward displacement of these remains.

In general the main parking lot area was characterized by a relatively thin scatter of cultural material, comprised mainly of bone fragments, FBR and lithic debitage. As mentioned, the heaviest concentrations were correlated with the areas of level or nearly level ground. In this development area this occurred along the eastern edge of the parking area. The western (upslope) and the north sections of the proposed lot were characterized by the lowest amounts of cultural material. It was our recommendation that, if the initial proposal for a large parking lot in this area was to proceed, mitigative excavations would only be required in the eastern area of the parking lot. However, it soon became apparent that the initially proposed lot was not acceptable due to its massive visual impact. Subsequent archaeological work was then structured around several alternate parking lot proposals as detailed below.

Parking Area Two: Revised Proposal

In response to concerns over the extent of disturbance to the heritage resource base and visual impact to site area some alternative parking developments were considered. In place of one large parking area,several smaller areas were proposed to augment a substantially reduced main parking facility.

The revised parking lot proposal, which was the final proposal tested during the 1983 season, consisted of a main lot located within the boundaries of the large lot first proposed but scaled down in size to about 40% of the original lot. The revised lot design occupied the same area to the southwest, west and southeast as the first proposal, but was cut back considerably at the north, northeast and east boundaries. This lot would now accommodate about 40 cars and six busses. In addition to this reduced main lot, a smaller secondary lot was proposed to lie about

25 m to the southeast of the main lot and adjacent to the access road (Figure 2). This second lot would handle about 20 cars. Finally, two small overflow parking lots were proposed: one was situated at the beginning of the access road where it turns in off of SR 516; the other about halfway between the turn in point and the main lot. These two overflow lots both lie entirely in the existing ditch of SR 516 and consequently were not examined for archaeological remains (Figure 4).

The reduced main parking lot and the smaller secondary lot were tested with shovel tests, backhoe trenches and excavation units. The diminished size of the newly proposed parking area allowed for a more detailed evaluation than was possible with the auger testing program. A total of 47 shovel tests were placed along a 10 m grid pattern which covered all the parking area development. Only three of the tests proved to be sterile two of which were located on the perimeter of the parking development area on the side of a slope up to a small knoll (Figure 12). The majority (68%) of the test units revealed two or more classes of material remains (ie. lithic, ceramic, bone, FBR; see Figure 13) concentrated in the upper 10 cm to 20 cm of the deposits. The variety and numbers of materials recovered in the shovel test units were much greater than those found in adjacent auger tests. This is presumably a function of the greater area excavated by the shovel tests and the greater control achieved by hand excavation. The shovel tests also provided an opportunity to view a scattering of soil profiles averaging 50 cm in depth. Observations derived from the soil profiles indicate several episodes of downslope movement that deposited large and small portions of bedrock materials, particularly in proximity to the base of the cliff slope. Test units placed away from the base of the slope displayed little or no evidence of colluvial deposition suggesting that this slope erosion and redeposition may be quite localized in nature.

The results of the shovel test evaluations indicated that some areas of the parking lot warranted further evaluation. The parking area was designated Area 11 and 11 excavation units were distributed over the test area (see Figure 11). The placement of the excavation units was predicated upon the results of the intensive shovel test program. Our intent was to locate units in the areas where we could expect the greatest amount of cultural material, or where the presence of natural

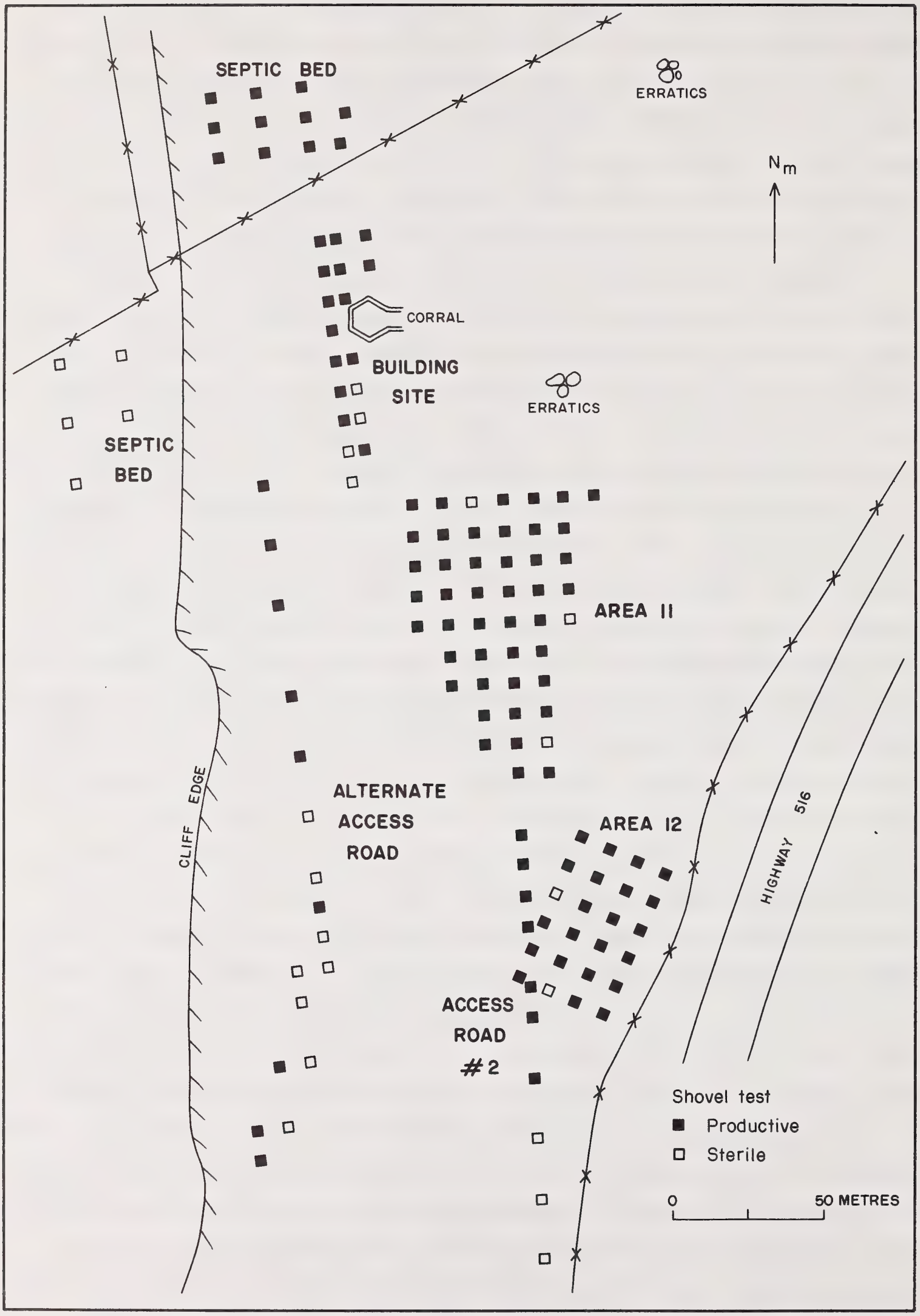

Figure 12: Results of shovel tests in development areas.

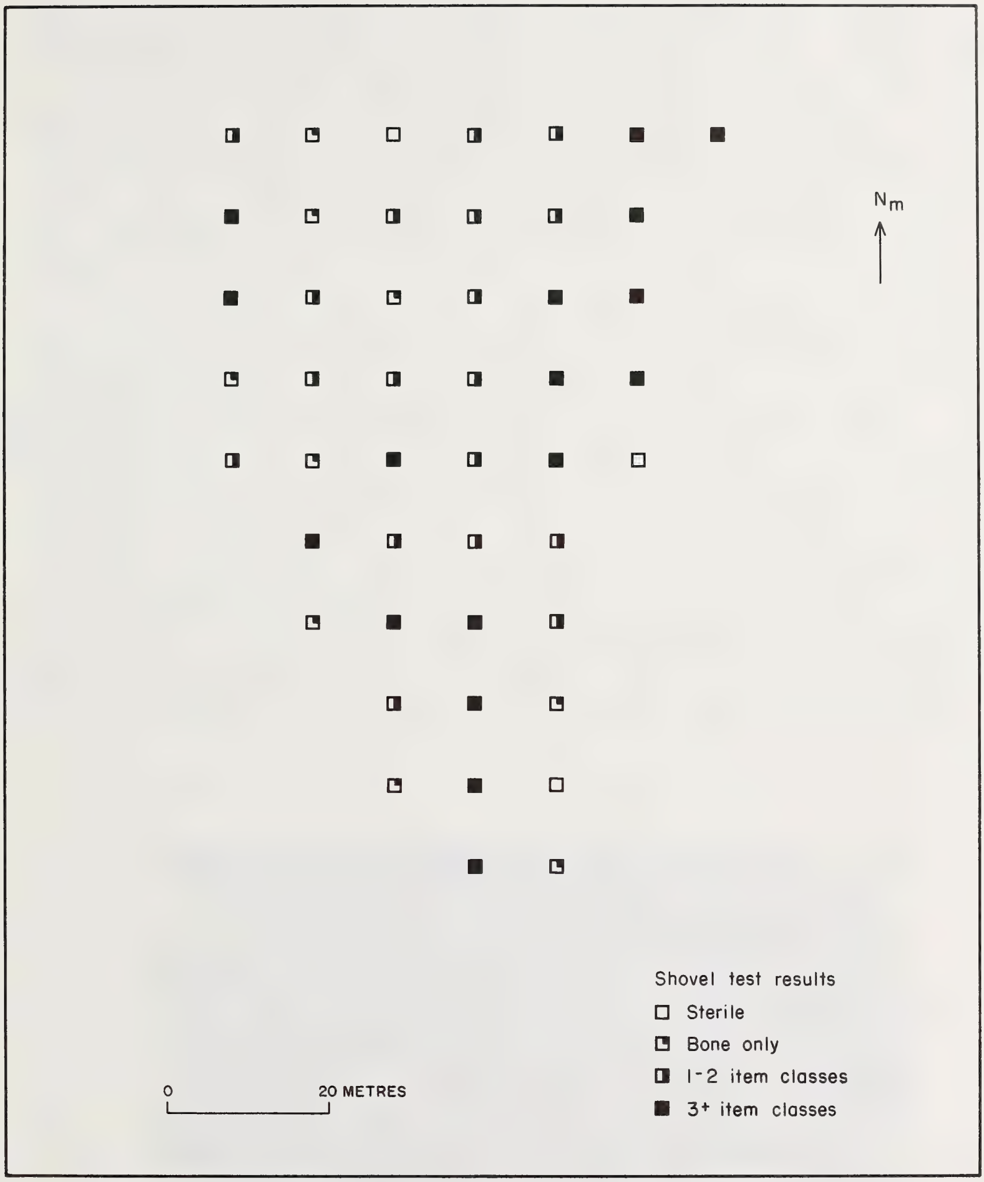

Figure 13: Results of shovel tests in Area 11.

stratigraphy indicated that separate cultural occupations might be discernible. Hence, most of our units were situated near the east end of the main parking lot where the ground was fairly level and artifact return from the shovel tests was relatively high; or they were placed near the start of the steep slope up the slump blocks where tests had indicated the presence of stratified soils (Figure 14).

The test excavation units consisted of ten 2 m^2 and one 1 m^2. In one instance four squares were placed together resulting in a 4 m^2 excavation while the remaining units were paired and thus yeilded three 4 m x 2 m units. The 1 m test unit was excavated adjacent to the south wall of test Unit 4, to expose a subsurface feature which was recognized in the profile of Unit 4. The positioning of the excavation units proved to be an accurate reflection of our predictions based on the results of the shovel test excavations. Units 1 through 4 occupied a slight slope near the eastern boundary of the parking area. Units 8 and 9 were located only 3 m to the east of the former units on more nearly level ground and yielded substantially more artifactual remains. None of the former units contained remains below 20 cm deep. This stands in marked

Figure 14: Photograph of excavations near base of slump block in Area 11.

contrast to the results from Units 5 & 6 which were located at the southwest terminus of the parking lot adjacent to the base of the slope. Here deposits were recorded to depths of over 60 cm and well preserved paleosols were noted in the profile. The colluviation that was evident in the shovel test pits was clearly demarcated in these latter units by large sandstone block fragments occurring in discrete lenses that sloped to the southeast.

The final two units, 10 and 11, were located on gently sloping surfaces in the middle of the proposed parking area, and like Units 1 through 4 produced few artifactual remains. The details of the Bison remains recovered are recorded in Table 2. It is clear that the distribution of faunal remains is not uniform between the excavation units, with Units 1 thru 4, 8, 10 and 11 yielding only a very few identifiable bison elements. In contrast, Units 5, 6 and 9 contained numerous identifiable elements. In the case of Unit 9 this was due to the presence of a subsoil pit feature which contained abundant lower limb elements particularly carpals and tarsals. Units 5 and 6 revealed a more diverse assemblage of elements representative of most of the bison carcass, a pattern not seen in any of the Area 1 excavation units. The cause behind such a pattern is not clear at the present time but may be related to factors of local redeposition and scavaging activities. We are quite sure that at least some of the bone from Units 5 and 6 originated upslope and has been redeposited by colluvial activity. The wide range of elements represented in these units may reflect a relatively complete assortment of bison skeletal parts buried in the slump deposits above. This would be consistent with our belief that the bone from the slump deposits away from the main kill is the result of scavenging or of the occasional killing of solitary bison who may break out of the main herd just before the jump off, or who survive the fall and who attempt to escape by moving laterally along the cliff face rather than downslope. Little can be said regarding the distribution of FBR except for the fact that over 50% of the Area 11 assemblage by weight was derived from the contents of a single pit feature (see Table 21). Lithic remains consisted predominantly of small pieces of debitage with few formed tools. The tools that were recognized consisted mainly of marginally retouched or utilized flakes with few bifaces or projectile

Table 2: Bison elements recovered from area 11 excavation units.

Bison Elements

Excavation Units	Head	Hyoid	Cervical Vertebra	Thoracic Vertebra	Lumbar Vertebra	Sacrum	Caudal Vertebra	Ribs & Sternebra	Pelvis	Scapula	Humerus	Radius/Ulna	Carpals	Metacarpal	Femur	Patella	Tibia	Tarsals	Metatarsal	Metapodial	Foot	N
1										1												1
2																						
3																						
4								1										1				2
5	2		3					1				1	3	1	1		3	10	1		14	40
6	2		1						1	1		4	7	2			3	2	2		19	44
7														1							3	4
8																						
9	3										2		7			1		3			6	22
10																				1	1	2
11																						
N	7		4					2	1	2	2	5	17	4	1	1	6	16	3	1	43	115

points. Notably at least one Besant projectile point was recovered in addition to Avonlea and Old Woman's which predominate in all other areas of the camp/processing site.

Two subsoil pit features recorded in Area 11 were of particular interest for they provide types of data not available in the compressed stratigraphic record. The detailed analysis and illustrations of subsoil pit features are presented elsewhere in this report. Although disturbed by rodent burrows, feature one from Unit 7 (Figure 69) revealed a thick basal deposit of charcoal in association with fire reddened sediments, a large slab of sandstone and several elements from the lower limb of a bison. In profile the feature appeared as a deep, steep sided basin. It is possible that this feature represents the remains of a dry roasting pit (Lowie 1954:25) which was subsequently infilled with surface debris. A carbon 14 assay on the basal deposits of the pit yielded an estimated age of 1160 ± 50 BP (ACVE-21c).

The second feature was identified in Unit 9 (Figure 70). The basal zone of this feature revealed a thick charcoal lense overlain by a jumbled matrix of FBR and bison bones. Included with the feature fill were several formed lithic tools and ceramic portions. The morphology of this feature, given its shallow basin shape, suggests a different use than that postulated for the feature in Unit 7. Although the presence of bone and FBR is suggestive of cooking or bone rendering through stone boiling the basal lense of charcoal is at variance with such an interpretation. It is likely that the charcoal lense was created while the pit was in use, but that the bone, FBR, lithic and ceramic remains were deposited subsequent to the abandonment of the pit or during an episode of reuse. The basal charcoal layers of the pit feature yielded a radiocarbon date of 1300 ± 70 (ACVE-22c).

In order to test for the possibility of deeply buried remains two backhoe test trenches were excavated in Area 11 (see Figure 11). The trench adjacent to Units 1 through 4 and 8, 9 was excavated to a depth of 4 m. The trench encountered massive sandstone blocks at 3 m with smaller concentrations of sandstone visible at 1.3 m below surface. The latter zone produced a number of lower limb elements from a bison which returned a radiocarbon assay of 7065 ± 175 B.P. (S-2500). There was no cultural material associated with this bone and its significance is open to speculation. The limb elements recovered were largely complete or broken by the backhoe. We noted no evidence of butchering, either green bone fractures or cut marks. It would appear that this find represented an animal which died of natural causes. However the find is important in that it indicates the presence of fairly deep material of considerable antiquity and raises the hope that cultural occupations of similar antiquity may yet be found below the compressed record of Late Prehistoric materials. The profile of the backhoe trench revealed a massive buildup of alluvium and aeolian sediments with no evidence of distinct paleosol development. A second trench was excavated along the western margins of Units 5 and 6 to a depth of 3.9 m. The latter excavation units revealed two distinct paleosols in the upper 60 cm of the deposit and the trench revealed other stable soil formation periods at 1.5 and 2.0 m below surface. None of these zones produced artifactual remains but an isolated portion of bison bone was recovered at 1.5 m.

The small, secondary parking area located south and west of the main parking area (Figure 2) was tested using a combination of shovel tests, excavation units and a single backhoe trench. A total of 24 shovel test units were excavated on a 10 m grid (Figure 12, Area 12). Only two of the shovel test units proved to be sterile, while 62% of the units contained two or more classes of material remains (i.e. ceramic, bone, FBR, lithic) (Figure 15). The majority of the remains occur in the upper 10 to 20 cm of the deposit but some test units produced bone remains below 50 cm. The tests with deeper materials were those placed to the western edge of the parking lot nearest the steep slope of the escarpment (Figure 14), where colluvium has built up deeper, stratified soils (Figure 16). Several elements of canid were recovered in association with bison suggesting once again that scavenging may have been a common occurrence in the development area. A total of four 2 m^2 excavation units were placed in the auxiliary parking area to evaluate the nature of these deposits. Despite the promising nature of the shovel tests remarkably few remains were recovered from the excavation units. Units 1 and 2 (see Figure 11) were located south and upslope of Units 3 and 4 and produced the fewest number of specimens. The remains were scattered throughout the units and did not appear to concentrate in any particular level or with a specific paleosol. The nature of the bone recovered

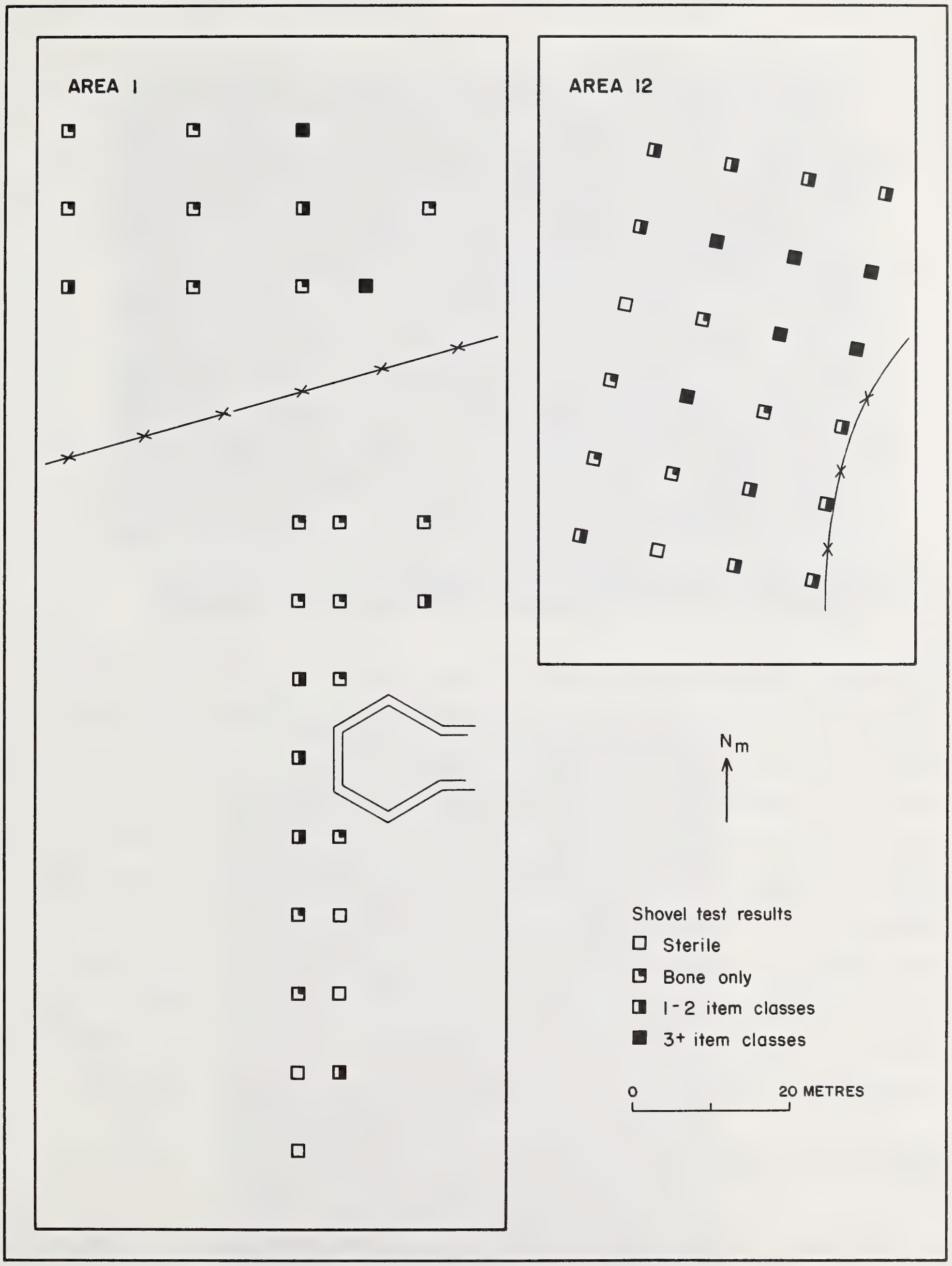

Figure 15: Results of shovel tests from Area 1 and 12.

Figure 16: Photograph of soil profile in Unit 2, Area 12.

indicated scavenging as the most likely agency of deposition (Table 3), and no artifact concentrations or features were located that might indicate transient occupation of the area. The excavation of the backhoe trench to a depth of 2.9 m revealed additional paleosols but no substantial cultural deposits. A thin but very consistent lense of bison bone was recorded at 60-75 cm below the surface (Figure 17) but the absence of artifactual remains precludes the inference of cultural activities at this level. In consideration of the heritage resources recovered from Area 12 there was no need to request any modification to the auxiliary parking proposal, and no further archaeological studies are recommended. All surface stripping should, however, be monitored.

BUILDING SITE AND SEPTIC FIELD

The location of the building site has remained largely unchanged in light of the numerous alternative road access and parking area proposals. Because the building is designed to be largely underground and built into the slope of the cliff face the subsurface disturbance was going to be extensive. The building will straddle the cliff face and

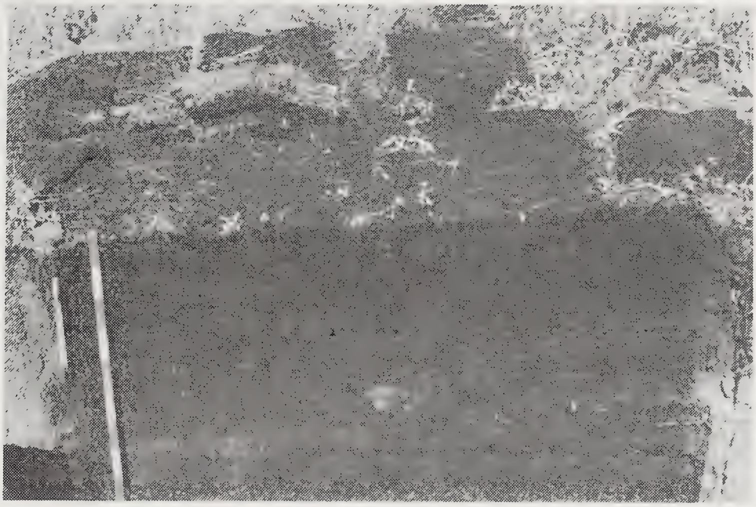

Figure 17: Photograph of soil profile in Unit 4, Area 12.

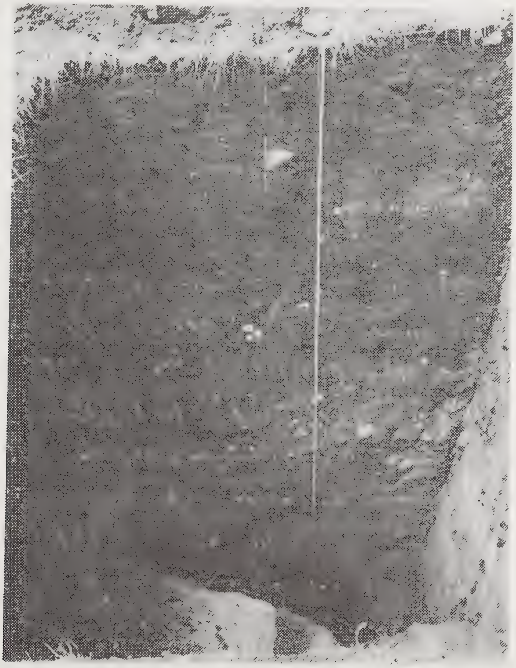

Figure 18: Photograph of soil profile in Unit 1, Area 1.

slump deposits, extending from the sandstone bedrock outcrops at the top to the toe of the slope (Figures 2 and 4). Our concern with this development was the possibility that this part of the cliff may have been used as a buffalo jump. As far as we could determine, none of the studies conducted by Reeves or Wettlaufer had ever tested this area and the extent of the jump deposits to the south of the spring channel is unknown. As discussed above, we also received verbal indications of possible placement of a septic field near the building site. The building area was tested using shovel tests, auger tests, excavation units and backhoe trenching. The proposed locations of septic beds were evaluated using shovel tests exclusively.

Two 2 m^2 excavation units, designated Units 1 and 2, were located on the upper part of the slope near the cliff edge in the area where the building is to be placed (Figure 11). Units 1 and 2 were excavated to depths of 3.8 and 1.2 m respectively. Excavation of the two units on the slope revealed a soil matrix consistent with that expected from the processes of slope wash, slumping, rock topple, and especially aeolian loess deposition. Soils in the upper 1-1.5 m of both units were a dark brown, organic rich loam with abundant sandstone rock fragments. Below this depth the soils gradually became lighter in colour, more compact and of a sandy silt texture (Figure 18). Sandstone fragments were found throughout the excavations but often occurred as lenses apparently representing major episodes of slumping or topple of the friable and platy bedrock.

The two 2 m^2 excavation units yielded essentially identical results. In both cases large, well preserved bison bone elements were recovered. Bones were found from just below the ground surface to a depth of 3.5 m in Unit 1. The greatest concentration of bones occurred in the upper 50 cm in both units, however even these "concentrations" consisted of a scattering of bone elements. Below this depth bones occurred occasionally in both units to a depth of 1.2 m, and then rarely below that depth. No obvious occupation layers, bone bed or butchering units were detected. No smashed or burned bone was recovered. Neither unit produced a single lithic artifact or evidence of cultural occupation. No organization or patterning of bone was detected which would suggest in situ butchering or processing. While many bones were

Table 3: Bison elements recovered from area 12 excavation units.

Bison Elements

Excavation Units	Head	Hyoid	Cervical Vertebra	Thoracic Vertebra	Lumbar Vertebra	Sacrum	Caudal Vertebra	Ribs & Sternebra	Pelvis	Scapula	Humerus	Radius/Ulna	Carpals	Metacarpal	Femur	Patella	Tibia	Tarsals	Metatarsal	Metapodial	Foot	N
1																					2	2
2						1							1		1							3
3				2									2					1			5	10
4	4				1			1				2	2		1			3			9	23
N	4			2	1	1		1				2	5		2			4			16	38

broken in ways similar to those expected from cultural processing, most of these could not be reliably separated from fractures caused by large scavengers (Haynes 1980, 1983, Bonnichsen 1979).

In short, the two excavation units were not sterile in that bison remains were recovered but all indications are that the area being tested was not part of the buffalo jump. Instead we suspect that the bones recovered from this area are the by-product of having a massive kill site used for nearly 6000 years located a few hundred metres to the north. Obviously, over time the kill site deposits will get spread over a fairly wide area. Scavengers were no doubt a major cause of this distribution and we believe that large scavengers such as dog, wolf and coyote were responsible for most of the bone recovered from the tests of the building site.

At the completion of the two 2 m^2 units, both were extended deeper by means of augering two 25 cm holes in the bottom of each pit. Unit 1 was augered to a depth of 5.2 m, and Unit 2 to a depth of 3.5 m. As a further check for the presence of deeply buried remains a backhoe trench was excavated south of the two excavation units (Figure 11). The upslope end of the trench reached a maximum depth of about 1 m before encountering a bedrock shelf. The lower end of the trench reached 3.2 m below surface. There was no substantial difference in matrix or the kinds of remains recovered from the backhoe test as compared to the findings of the excavation units. Consequently the conclusions made based on the excavation units were supported and the building site was clearly not going to impact significant cultural deposits.

The lower, downslope end of the building will be largely above ground and deep testing was not required. This area is not as steeply sloping and there is a narrow, gently sloped bench formation near the base of the proposed building which was selected for shovel test evaluations. A total of 18 test units were completed (Figure 12) of which nearly 30% were sterile and over 50% contained only bone fragments (Figure 15). The remains were all derived from the upper levels of the test units and no concentrations of artifactual remains were found. The few artifacts recovered are believed to represent the upper limit of the intermittent camping and/or processing which occurred a few metres downslope on the more level area near the main parking lot development. We also monitored the excavation of 5 m and 6 m subsurface backhoe excavations conducted by engineering consultants. Their work was aimed at exploring the suitability of the bedrock for building construction and their excavations were conducted within the proposed building site. As before, we noted the occasional bison bone, but no other evidence of cultural occupation.

Although there was never a final decision on the location of the septic bed, two potential sites were evaluated during the course of the field season (Figure 2). The first area proposed was situated immediately upslope and above the building site just back of the cliff face. Shovel tests here were completely sterile (Figure 12) and in many cases only 10 to 20 cm of sediment covered the bedrock shelf. Due to erosion and deflation it is unlikely that any evidence of cultural activity would remain intact in this area. The second site tested was immediately north of the building location on the slump deposits below the cliff (Figure 2 and 12). This area was assessed with 11 shovel test units. The location was covered with dense rose shrubs which made excavation quite difficult (Figure 19). All of the test units contained some remains notably bone (64%) with a few units revealing lithics and FBR. The results of the septic field shovel tests located to the north of the building are in striking contrast to all other testing of the building site area where no lithics or FBR were recovered. These shovel tests were moving progressively towards the major slump block terrace to the south side of the spring channel (Figure 2). This slump block is nearly identical in topography to that on the north side of the spring where the main bone bed is located. It is our suspicion that this southern slump block is as much a part of the main kill site as the northern slump block and that the shovel tests were beginning to encounter the remains of killing and butchering events.

For this reason we recommend against the use of this area as a septic field for the interpretive building. Certainly additional archaeological investigations of this area would be required if avoidance is not possible. Such tests would have to include excavation of a much larger area (i.e., 2 m^2 units), and would have to extend well beyond the depth of our shovel tests. We suggest as an alternative the use of the steep slump deposits located just south of the building site where our shovel

Figure 19: Photograph of shovel testing in north septic field.

Figure 20: Feature in plan view in development Area 1.

tests associated with the briefly proposed upper access road indicated a lack of cultural material.

At the close of the 1983 season it was anticipated that much of the future work in the development area (Areas 1, 11 and 12) would only involve monitoring of the road and building construction phases. This will still occupy some of our time in subsequent field seasons but it also appears that further assessment and mitigation may be required in the development area given recent adjustments to the development plans. This pertains specifically to the proposed relocation of the main parking area to the region formerly occupied by the secondary parking lot. Also, additional assessment and mitigation may be required as other minor developments are finalized. This will likely include gas and electrical lines, walking trails, the well and water line, and possibly further septic field assessment.

SUMMARY OF DEVELOPMENT ASSESSMENTS AND RECOMMENDATIONS

A fair portion of our field time in the 1983 season was devoted to the assessment and mitigation of potential impacts to archaeological resources as may be caused by construction of facilities associated with the public development of HSI. These studies were all conducted within a large area situated to the south and west of the main kill and processing site at DkPj-1. This development area was initially designated Area 1, and subsequently subdivided into Areas 11 and 12 to facilitate the recording of numerous types and locales of archaeological assessments. The same Borden number for HSI (DkPj-1) was employed throughout our tests, as we believe that everything we have so far examined is part and parcel of the operation of the jump.

The various development facilities examined in 1983 included: 1) an initial proposal for an access road linking SR 516 with the proposed building site; 2) a second entirely different alignment for an access road; 3) a tentative and short lived proposal for yet a third access road alignment; 4) an initial proposal for a single main parking lot to service the building; 5) a revised parking lot proposal utilizing a reduced main lot and a nearby secondary lot; 6) the site of the Visitor

Reception Centre; and 7) two informally proposed locations for a septic field to service the building.

All of these developments were subjected to various levels of archaeological assessment. Explorations were conducted using 50 cm^2 shovel tests, 25 cm diameter auger holes, excavation units of 1 m^2 to 2 m^2 in size, and backhoe trenches. All tests except the backhoe trenches were screened with 1/4" (6.3 mm) mesh. All excavations were conducted using 10 cm arbitrary levels and horizontal provenience was maintained to a 50 cm^2 area. Features, bone and FBR concentrations were mapped in plan form. Features were cross sectioned and profiled and matrix samples were collected and floated.

Most of the development facilities were found to pose little threat to substantial deposits of archaeological resources. This summary will only discuss the developments which are seen to pose a threat to significant historical resources. One major conflict identified during the May 1983 assessment was the initial access road. This alignment was found to transect rich deposits of shallow but dense archaeological material for nearly all of its path across the level prairie leading up to the slump deposits and cliff face. As a result, an alternate access road was conceived which traversed an entirely different area and was found to cause virtually no archaeological impact over most of its route.

Another site proposal deemed unacceptable by us was the initial large parking lot, although the visual impact of this feature was the prime reason for recommending against the use of this lot. This sentiment was shared by other government employees who are part of the HSI development project and several in-field meetings were held to negotiate a revised parking proposal. The subsequent revision was deemed more acceptable by all, from both a visual and archaeological perspective.

Finally one of two proposed locations of the septic field was found to lie in an area where seemingly significant archaeological deposits were discovered. This proposal placed the septic field to the north of the building site along the slope of the slump deposits. Here, we believe, the brief shovel test assessment program encountered cultural materials associated with the primary kill site. It is therefore recommended that this area not be considered for the septic field. It should be noted that there has never been a formal proposal for the septic system and that our assessment of two alternate locations was based solely on verbal indications from the architect. In the absence of any formal septic development plans, we would propose a location to the south of the building site in about the middle of the slump deposits. This is essentially an identical location to that examined, although it is situated to the south rather than north of the building site.

Thus, the first two conflicts between site development and archaeological resources - the first access road and first parking lot - have already been altered to lessen adverse impacts. As these alterations were enacted during the 1983 field season we were able to continue our assessments of the revised development plans. The revised access road, originating from the southwest, was evaluated with auger holes, shovel tests, and coincidently with 2 m^2 excavation units in the areas where the road passes through the proposed parking lots. The majority of the road alignment (about 350 m) passes through the existing ditch alongside of SR 516, or across steeply sloping terrain adjacent to the sandstone escarpment. All tests here indicate a near total absence of cultural materials. The only portion of the revised road alignment which is of concern is the final 100 to 150 m where it passes through the area now designated as the reduced main parking lot. Our tests of this area demonstrated that, although relatively low amounts of cultural material were present, intact and well defined features were present. These features are believed to be related to events associated with bison processing; including roasting pits, bone boiling pits, and hearths. The subject of bison processing is one which we deem to be of considerable importance. This is because it is a little studied and hence poorly known facet of communal kills. It is obvious that future years of archaeological research at HSI will necessarily focus on the processing site. Given this accepted long range research focus we consider it important to record as much evidence as possible pertaining to bison processing. The well preserved features in the area of the main parking lot and north end of the access road offer an opportunity to record evidence of these events. As discussed below, features are also present in the main site processing area, but many of these are not as well preserved as those located peripheral to the areas of heavy utilization.

Our excavations give us reason to believe that other processing features will be found within the boundaries of the revised main lot and north end of the access road. We do not recommend additional exploratory excavations designed to locate these features, since the data return will be very low when no features are encountered. Instead we recommend that the construction of these facilities proceed in such a manner that the entire area of concern is first stripped of about the upper 10 cm of soil. Our excavations demonstrated that this will serve to expose the upper outline of the features (see Figure 20). After this stripping, construction activities could proceed elsewhere and an archaeological crew would record and excavate all exposed features. The time needed for this work would depend entirely on how many features are revealed but is not expected to take more than two to three weeks of full time work.

The situation with the parking lots is essentially the same as that for the access road. The southernmost overflow lots are of no concern because they lie in the existing road ditch and are already completely disturbed. The secondary lot currently proposed to be situated south of the revised main lot is also of little concern as our shovel tests and four 2 m^2 excavation units yielded minimal amounts of material and no features. However the revised main lot area lies in the same area as the north end of the access road. As with the access road, the main lot lies in an area where few artifacts were recovered but where intact features were recorded. For the same reasons discussed above we recommend that this lot also be stripped of the upper 10 cm of soil, monitored, and then followed by feature excavations. Since the parking lot overlaps the same area as the north end of the access road the time and amount of work involved does not differ from that suggested above.

The third area of conflict between site development and archaeological resources is the proposed placement of the septic field to the north of the building site. Unlike the access road and parking lot conflicts, no on-site alterations to the septic proposals were made in 1983. This is due largely to the fact that no formal proposal ever existed for this development. Also it is relatively small in size compared to other site developments and construction deadlines dictated a much greater need for rapid decisions on road and parking lot placement. As of this writing there is still no formal proposal for a septic field and our concern in this report is simply to indicate that this one location, to the north of the building, is a poor choice from the perspective of archaeological resources. We suspect that this location is moving dangerously close to the slump block on the south side of the spring channel where, despite the absence of archaeological tests, we have good reason to believe a major bone bed of the kill site deposit is located. Therefore we recommend this location be dropped as a prospective septic bed. The tests of the alternate septic bed on the top of the sandstone escarpment were entirely sterile and it is thus a more suitable location from our perspective. However, the general absence of topsoil and the proximity of bedrock near the ground surface suggest to us that this area would be unsuitable for the purposes of a septic field. For this reason we have recommended the septic field be placed on the slump deposits to the south of the building site. This area was tested with shovel tests and two backhoe trenches in association with the third proposal for an upper access road. This access road, which is no longer being considered, crossed through the middle of the slump block on the south side of the building where a slight bench forms a break in the slope (Figure 2). Our tests here yielded results essentially similar to that of the building site; i.e., only a few scattered bison bone elements. We have no hesitation in recommending this location for the septic field with the standard requirement that all excavations in this area be monitored by our crew.

SECTION THREE

1983 EXCAVATIONS AT DkPj-1: RESEARCH AREA

INTRODUCTION

In previous studies of the Head-Smashed-In Buffalo Jump the majority of the research has been focussed upon the bone bed deposits of the kill site (Bird 1938, Wettlaufer 1949, Reeves 1978, 1983b). Although both Wettlaufer and Reeves excavated in the processing area, little information is available on the nature of these deposits. The prehistoric activities which were conducted in the camp/processing area were a logical continuum of the primary processing undertaken at the kill site and only through the ellucidation of these activities can the entire pattern of bison exploitation by prehistoric Plains hunters be understood. Indeed, a review of the literature on buffalo jumps in the Northwestern Plains (Frison 1978) indicates a strong bias towards the excavation and analysis of kill site deposits and a relative avoidance of the associated processing areas. We suspect this is due largely to the spectacular nature of the bone bed deposits, the usually excellent bone preservation, the presence of stratified deposits, the high incidence of projectile point recovery, and to the growing interest among contemporary archaeologists in the sophisticated analyses which large faunal samples permit (eg. Reher and Frison 1980; Binford 1978, 1981, 1984; Speth 1983; see also Gifford 1980).

Processing areas, in contrast, contain much the same physical data but often present these data in ravaged form. By definition these areas are characterized by the remains of reducing the bison carcasses to useable, storable foods. The meat, fat, organs, hides, bone and horn are converted into preserved supplies and items of material culture. From an archaeological perspective these processes are essentially destructive to the material record and create major interpretive problems for the scientist. Nevertheless, we believe these events cannot be ignored. The slaughter of dozens or hundreds of animals at a time is good for little more than a few days of feasting unless steps are taken to preserve the massive food source represented at most communal kills. If we accept

Frison's argument (1972, 1978) that the main purpose of these great communal kills was to acquire stored provisions, especially for the winter months, then we realize that the latter stages of the hunting continuum are a little studied and poorly understood aspect of Plains prehistory.

Thus the research component of the 1983 field studies at Head-Smashed-In Buffalo Jump focussed on the deposits of the camp/processing area and a number of research problems and questions were proposed. Many of the questions posed involved determination of the nature and aerial extent of the camp/processing area. Previous investigators had reported the existence of relatively deep (about 75 cm), non-stratified cultural remains in association with distinct subsoil pit features (Reeves, pers. comm.). Although no architectural features were reported the incidence of subsoil pit features and density of refuse were suggestive of localized activity patterning. Investigation of these kinds of data would help to establish if the camp/processing area was the result of sequential occupation of the site by the same group in the same locations, or whether many different groups exploited widely separated areas of the camp/processing area. Along a similar line of reasoning it should be possible to equate the cultural groups presently identified in the jump deposits with those represented in the camp/processing site. The discovery of anomalies in the various groups represented might have an important influence upon reconstructions of site exploitation during the prehistoric period. For example, is it possible that some groups were occupying the camp/processing area without exploiting the buffalo jump facility (eg. Paleo-Indian groups?). In 1949 Wettlaufer collected a Scottsbluff projectile point from a disturbed context near the spring channel on the prairie level. Yet Reeves' excavations in the bone bed recovered no evidence of buffalo jumping prior to 5500 B.P. (Reeves 1978). One of our goals for the 1983 season was to attempt to confirm or refute the Paleo-Indian occupation suggested by Wettlaufer's find. Reeves (1978) has identifed some gaps in the sequence of bison jumping activities represented by the bone bed data. Are these same gaps also discernible in the camp/processing area? If such gaps are not represented in the camp area what does this have to say regarding the disuse of the jump site?

It is important to remember that the use of the buffalo jump and harvesting of the products derived from the bison represent only one, albeit very significant, facet of a multidimensional season round of settlement-subsistence activities. In order to tie the Head-Smashed-In Buffalo Jump site into such a model of settlement and subsistence in southwestern Alberta it is first necessary to investigate the activities and groups represented by the camp/processing deposits.

In a general sense, the non-mitigative studies conducted at HSI in 1983 represented our introduction to the nature and extent of the processing remains on the prairie level below the cliff. Since little information about this area was available from previous studies, our first season's work may best be viewed as a fact-finding test. In order to pose relevant and meaningful questions we had to have some idea of the nature of the data base. Excavation units were placed so as to sample a fairly extensive area of the processing site rather than to conduct intensive tests of a specific part of the site. This section of the report presents the results of our excavations at the main processing site of DkPj-1. Again, the detailed analyses of materials recovered (fauna, lithics, ceramics, etc.) and of features is presented in a subsequent section.

METHODOLOGY

As a result of previous casual surveys in the Head-Smashed-In site area a number of discrete concentrations of artifactual remains and architectural features had been identified over an extensive area below the jump. These concentrations were detected because of the shallow soils and low deposition which characterizes most of the processing area and have resulted in the exposure of cultural material. Bone fragments, FBR and lithic tools are visible over much of the site surface and in places this is augmented by increased exposure caused by cow trails, old cart and truck trails, and blowouts. Upon our arrival at HSI in 1983 it was decided to preface our excavations in the processing area with a systematic foot traverse of a large area below the cliff. This would aid in delineation of areas, based on surface exposure, of differential artifact density, architectural features and specific artifact type occurrence. A belt of land paralleling the cliff face approximately 30 hectares in size was selected for foot survey. This area was divided into a number of survey areas whose perimeters were defined on the basis of topographic features and fence lines. The area was walked systematically by pairs of individuals spaced approximately 5 m apart. Later the team approach was abandoned as less experienced crew became familiar with the local artifactual remains and features of interest. During the course of the walk crew would place flagged pins on artifact locations and at the conclusion of the walk would record observations on the relative amounts and kinds of materials encountered during the traverse. The position of the flags was noted on a larger map and the crew's observations appended. The survey proceeded in a stepwise manner sweeping the survey area until the entire zone had been covered. Areas of denser vegetation were recorded in order to distinguish areas of no artifactual remains from those which could not be visually examined because of some impediment. Although the system worked well in relatively small zones with several topographic landmarks, those areas which were larger and relatively featureless often frustrated straight line transects and some of the plotted finds are more impressionistic than exact cartographic locations. The survey was successful however in demarcating what we believe to be the extent of the main processing area, as well as more distinct sites that may or may not have been directly associated with the use of Head-Smashed-In Buffalo Jump. Thus, the initial walking survey was instrumental in assisting in the placement of our excavation units within the processing site. The methodology employed in excavating shovel tests and larger excavation units was identical with that specified at the outset of the report.

EXCAVATION UNITS - RESEARCH AREA

A total of seven excavation units and two shovel tests were completed in the camp/processing area during the 1983 field season. Additionally two partial 1 m^2 were excavated for purposes of exposing a profile face in the spring channel which bisects the main prairie level camp (Figure 21). These latter two units are dealt with in a separate report provided by Richard Morlan which is included as Appendix one. The results of this

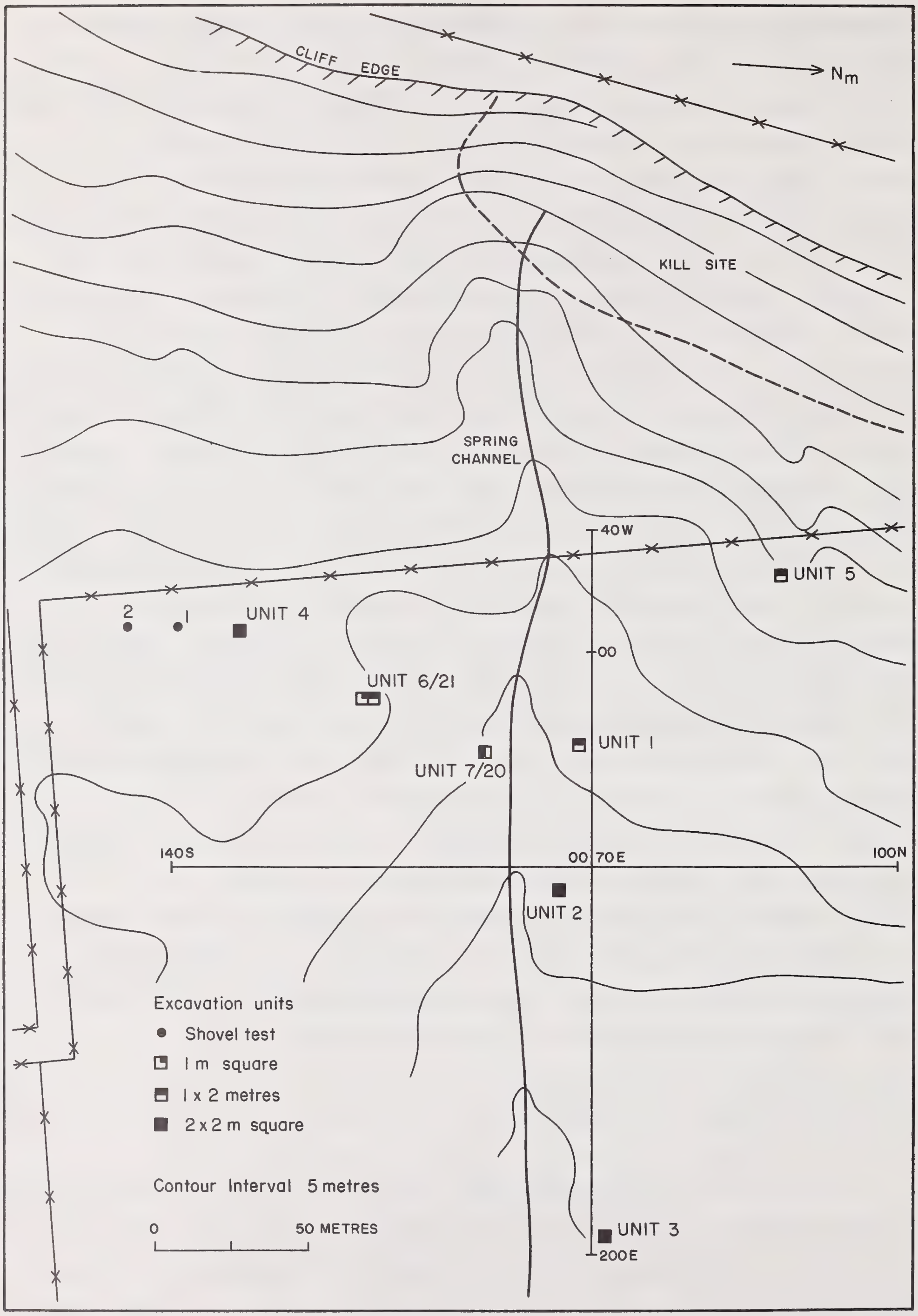

Figure 21: Map of excavation units in research area (Area 2).

section of the camp/processing site excavation will only be briefly summarized in this portion of the report.

Although a number of researchers had undertaken excavations within the camp/processing area prior to the initiation of the 1983 field program, there were few details available on the location of these units or the materials recovered. Fortunately the researchers who conducted the work were available and Messers. Wettlaufer, Getty and Reeves are thanked for their efforts with respect to locating the position of former excavation units on the prairie level. It was evident from the surviving field notes and photographic documentation that a rich deposit of bone, FBR and subsoil features had been encountered in this area. It was unclear however what the extent or nature of this deposit might be, and our test excavations were distributed over the camp/processing area so that an appreciation of the structure of these deposits might be garnered.

Estimates supplied by our informants as to the maximum depth of the cultural deposits varied widely, ranging between values of 75 cm to estimates of less than 30 cm in depth. It appeared that the deposits across the processing area had been compacted as a result of erosion through deflation and subsequent compression through trampling. This collapsed archaeological deposit offered little hope of recovering intact strata except in those areas of the site which have acted as sediment traps, such as the spring channel. Part of our 1983 research objective was to evaluate the various personal descriptions of the nature of the archaeological deposits in the processing area as provided to us by previous excavators of HSI.

It was evident from surface finds observed during our walking survey that the southern portion of the camp/processing area on the south side of the spring channel was the richer of the two areas. It was also evident that the quantities of surficial remains decreased proportionally with increasing distance from the main kill site. In order to determine the nature of the deposit in both a horizontal and vertical perspective excavation units were placed on both sides of the spring channel and distributed so that local anomalies in topographic relief might be assessed as to their influence on prehistoric community or activity level patterning. The excavation units were positioned so that Units 1, 2, 3 and 5 were located north of the gully, and Units 4, 6 and 21 were located south of the gully (Figure 21). The results of the excavations will be discussed according to the test area involved and the excavation unit.

A grid network was established over the camp/processing area using two 240 m long baselines which were established using a transit and surveyor's chain. The excavation units were demarcated by wooden corner stakes and the position of each stake, northing and westing, was marked on each stake.

Unit 1

This unit measured 1 x 2 m and was located on gently sloping ground adjacent to the north side of the spring channel (Figure 21). Surficial deposits of historic materials such as square nails, round nails, window glass and shell casings suggest that at one time an historic structure may have been located in the vicinity. A nearby depression measuring approximately one metre square may have been associated with the debris but the anamoly was never tested. Interestingly enough a 1924 topographic map locates a building of unknown size in approximately the same area but no foundation or any other structural remains were noted during excavation. In addition to the historic materials the area revealed numerous small cobbles of sandstone, both on the surface and below surface. We believe these represent the downslope erosion of bedrock materials from the cliff face. In addition, some of the surface and near surface bedrock pieces were likely deposited during the excavation of a deep dragline trench which was cut through the slump block deposits by the Geological Survey of Canada in 1965. Certainly the deeply buried sandstone fragments are the result of continuous downslope movement of the materials in prehistoric times. Excavation units located further downslope did not reveal the abundance of colluvium seen in Unit 1 and this is no doubt due to the increased distance from the steep slope of the slump block.

The excavation of this unit proceeded quite slowly because of the dense tangle of bone, FBR and sandstone colluvium. It proved impossible to excavate such a matrix rapidly and most excavation was restricted to grapefruit knives and brushes until the base of the second level was reached, whereupon the concentrations of material diminished markedly.

Bone remains were concentrated in the zone from 0 to 15 cm below surface, with few pieces below 15 cm. Owing to rodent disturbance throughout the camp/processing area some downward movement of cultural material was expected and was noted. Most such occurrences were easily detected through the observation of recent and fossil rodent burrows, which displayed a darker and softer soil matrix. For reasons which will be discussed below bone recovered from this unit was highly fragmented, as evidenced by the over 4000 gm of unidentifiable bone recorded. The elements which could be identified include the cranial and post cranial portions of the bison skeleton but the majority of the remains (81%) are derived from the lower limb bones, particularly the robust carpal and tarsal bones (Table 4). The representation of the bison elements from this unit and from the processing area in general may have more to do with factors of differential element survival than cultural selection. This argument will be discussed in greater detail below. A good deal of the bone in the non-identifiable class was burned and there was ample evidence of heat related activities in the form of FBR. Mapping the distribution of FBR did not provide any indication of patterned distributions. Rather, the FBR appeared as a dense blanket which covered the 1 x 2 m unit. No doubt patterns of FBR distribution reflective of specific site activities once existed but have been obscured by repeated occupation of the area and the consequent superposition of FBR from multiple use and reuse.

There was some confusion at the outset as to whether the sandstone present in this and other units had in fact been utilized or modified by exposure to heat. Some of the specimens displayed a reddening that is inferred to represent the oxidization of the iron minerals in the sandstone. Others revealed no obvious discoloration yet were in close association with limestone FBR specimens. Ultimately it was decided that only these pieces of sandstone with a distinct red colour would be recorded as FBR. Experimental studies using sandstone as boiling stone material were initiated in 1983 and will be expanded in 1984 to determine the attributes of heat altered sandstone. Our studies were relatively crude experiments designed only to give us an idea of whether or not sandstone would function as a boiling stone. At our camp, pits were excavated, lined with plastic, and filled with water. Non-sandstone and

Table 4: Bison elements recovered from area 2 excavation units.

Bison Elements

Excavation Units	Head	Hyoid	Cervical Vertebra	Thoracic Vertebra	Lumbar Vertebra	Sacrum	Caudal Vertebra	Ribs & Sternebra	Pelvis	Scapula	Humerus	Radius/Ulna	Carpals	Metacarpal	Femur	Patella	Tibia	Tarsals	Metatarsal	Metapodial	Foot	N
1	1		1		1		1			1		1	8	1			2	3	2		5	27
2	3			2				3			1				2		1	5	1	4	4	26
3	1																					1
4	26			5	5		4	19	1	5	3	18	27	7	7	4	9	41	14	5	86	286
5													1					2				3
6/21	13	1		3			2	14		2	4	9	15	4	1		9	9	3	1	18	108
7	9		1	1	2		1	13	1	5			2		2		3	2		2	5	49
20	17		9	11	4		2	28	3	6	1		3	1			3	6	1		9	104
N	70	1	11	22	12	-	10	77	5	19	9	28	56	13	12	4	27	68	21	12	127	604

sandstone rocks were heated in a large fire and then placed in the pits. We determined that sandstone would indeed heat the contained water fairly efficiently, and as a result of these findings we began collecting all reddened sandstone from our excavations. At this time we suspect that the preferable materials for stone boiling were limtestone and quartzite, but that this was augmented with the occasional use of sandstone. The reason an inferior material would be used, we suspect, is that non-sandstone materials are not immediately available at the site and must be brought from sources some 2 km distant. The overwhelming dominance of non-sandstone boiling stones at HSI indicates that this transport was considered worthwhile, but the occurrence of fired sandstone in association with the non-sandstone pieces indicates that this rock was also utilized. The vast majority of the FBR recovered from Unit 1 were limestone cobbles. It is likely that these preferred materials were curated and only discarded when too small to provide efficient heat transference. Judging by the surface indications and excavated data, several thousand kilotons of cobbles have been transported to the camp/processing area during the last several thousand years.

Two ceramic pieces, neither of which was analyzable, were recovered from this unit. The majority of the remains were lithic debitage and several formed tools including one uniface, 11 bifaces and 15 retouched flakes. No features were found in this unit although two upright rib portions wedged between pieces of FBR and sandstone were initially identified as bone pegs (Heitzmann 1983). It was later determined that the rib portions were occupying the voids left by abandoned rodent burrows as denoted by the dark matrix surrounding the bone (Figure 76). There was no indication of proximal crushing or distal shaping of these bone pieces.

The southern quadrant of the unit was excavated to expose a soil profile and to check for deeply buried remains. On the basis of the excavated data it appeared that most cultural materials did not continue below 15 cm depth below surface, except where redeposited via rodent burrows or other disturbances. It was evident however that a few very small fragments of bone were showing up at greater depths and could not be explained away as the result of vertical displacement. Specifically, several small, badly weathered scraps were recovered 90 cm below surface.

The bone was poorly preserved and proved difficult to collect given its friable consistency and the surrounding matrix of cemented soil peds. It is likely that the local hydrological conditions are largely responsible for this poor preservation. It is difficult to surmize what the context and meaning of this bone might be. The depths are atypical of the general site deposit and there were no other associations such as paleosols or artifactual remains with the bone. The fragments themselves were small non-identifiable portions, presumably mammal, and insufficient for obtaining a C-14 dating estimate. It is possible that such bone may be the evidence of an early camp/processing activity. It should be remembered that bone from 1.3 m deep in the nearby development area yielded a date of 7,050 B.P.. It is equally possible that these few small pieces of bone are redeposited from upslope contexts, possibly originating in the bone bed. The processing area is noted for its inability to absorb heavy rains and prolonged downpours often promote sheet wash and extensive gully erosion. Such events may have transported bone from the upslope bone bed and redeposited the smaller more transportable pieces in the sediments of the camp/processing area. The soil profile from unit one is presented in Figure 22.

Unit 2

This excavation unit was located east and south of Unit 1 and measured two metres square (Figure 21). In contrast to Unit 1, the upper levels of Unit 2 were not littered with fragments of sandstone, nor was there the great density of FBR which characterized the upper 15 cm of Unit 1. There was however, ample evidence of local lithic manufacture in the form of abundant debitage composed of many raw material types and a wide variety of lithic tool type fragments.

The unit revealed a slight slope to the east and was in close proximity to the spring channel bank (Figure 23). The proximity of the spring channel may have had an influence on the recovery of an abundance of lithic materials, for the surface survey indicated that the numbers of surface finds declined markedly going away from the channel bank. Although the excavation of Unit 2 was not impeded by dense layers of FBR, bone, and sandstone fragments, it was characterized by a multitude of tiny debitage fragments the majority of which were less than 5 mm in

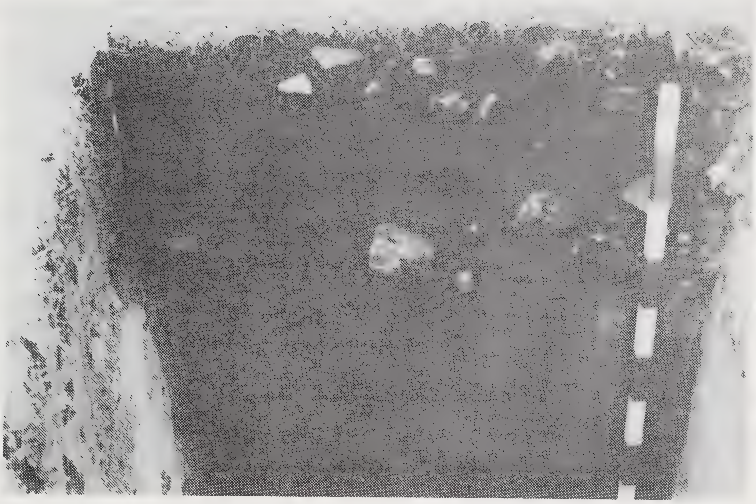

Figure 22: Soil profile in Unit 1, Area 2.

Figure 23: Excavations in Units 1 and 2, Area 2.

maximum dimension. The propensity for strong winds in the Head-Smashed-In area often reduced excavation techniques to a test of reaction time as small flakes were "gone with the wind" as soon as they were exposed. The bone recovered from the unit tended to be highly fragmented which, combined with a strongly cemented matrix, made intact recovery extremely difficult. Despite the fact that 4 m^2 of area were excavated only 26 identifiable bison bone elements were recovered (Table 4) along with 1264 gm of non-identifiable bone fragments. Most of the bone was confined to the upper most level of the unit but, once again, rodent disturbance had promoted some downward movement. There was no obvious concentration of bone or associations to suggest the presence of particularized bone processing activities. Plots of FBR distribution revealed clusters and linear arrangements but none could be interpreted as indicative of any particular cultural activity. It is interesting to note that despite the fact that Unit 2 was twice as large as Unit 1 it produced less FBR both by count and weight. This kind of relationship would support the hypothesis of a fall-off model of activity patterning at Head-Smashed-In; that is the closer to the bone bed the more frequent and intensive the activity. This results in greater numbers and densities of material remains. The possibility exists however that some zones within the camp/processing area were allocated for task specific activities and the presence of two hearth features in Unit 2 is suggestive of this pattern.

The two hearths were demarcated by oxidized sediments and did not appear until the upper level of FBR and bone fragments had been removed. There was no indication of these features in the distribution of FBR or concentrations of calcined bone recovered from Level One. The hearths were largely sterile except for very small bone fragments and the occasional fragment of FBR. A detailed discussion of the specific plan form, profile and matrix data for each hearth is provided in the section on feature analysis in this report. Water screening and flotation of the hearth matrices failed to reveal any microscopic remains. The hearths were overlapped and the profile indicated that one predated the other by the presence of invasive channels thought to have been caused by patterned ground effects which only appear in one hearth.

The above evidence would be in accord with the physical remains left by a surface hearth where the hearth is not excavated into the subsoil. Such a hearth may well have been rock-ringed. Following abandonment and dislocation of the ring stones through erosion or scavenging for other hearths or tent weights, only the oxidized sediment would be left to indicate the hearth location. The use of a rock-ringed hearth is consistent with the use of buffalo chip fuel (Wilson 1934, Dyck 1977), which given the context of the HSI locality was likely the principal material available for stone boiling, roasting and heat. The efficiency of buffalo chip fuel for heating boiling stones is of some interest for the HSI project given the massive quantities of FBR in evidence. Reports vary on the heating properties of this fuel in comparison to wood (Holland 1984) and several experimental evaluations are planned for the upcoming field season to determine the efficiency of different kinds of fuel.

The inventory of artifacts from this unit included a number of lithic tools, many of which were retouched flakes, and a total of 51 ceramic fragments, most of which weigh less than one gram. The sherds are extremely fragmentary and only one vessel could be identified. The shape of the vessel is indeterminable but the rim was insloping and decorated on the exterior with horizontal dentate stamp impressions. The body of the vessel appears to have been given a cord marked decorative treatment. Both of the latter attributes are consistent with the ceramic attributes associated with the Cluny Complex dating from the early 18th to the mid-19th century (Byrne 1973).

The soil profile for this unit is presented in Figure 24. Unlike Unit 1 no deeply buried bone fragments were recovered, but at least two episodes of colluvial deposition are denoted by bands of sandstone clasts. The hearth stain present in the upper left section of the profile is thought to be a continuation of one of the two hearths within the unit. Although the profile of the hearth feature appeared to terminate before exiting the square, the faint boundary of the stain and sterile substrate may have been drawn incorrectly. If indeed the oxidization present in the soil profile is separate from that found in the unit a third hearth feature could be present and would therefore define a complex assemblage of hearths for this unit.

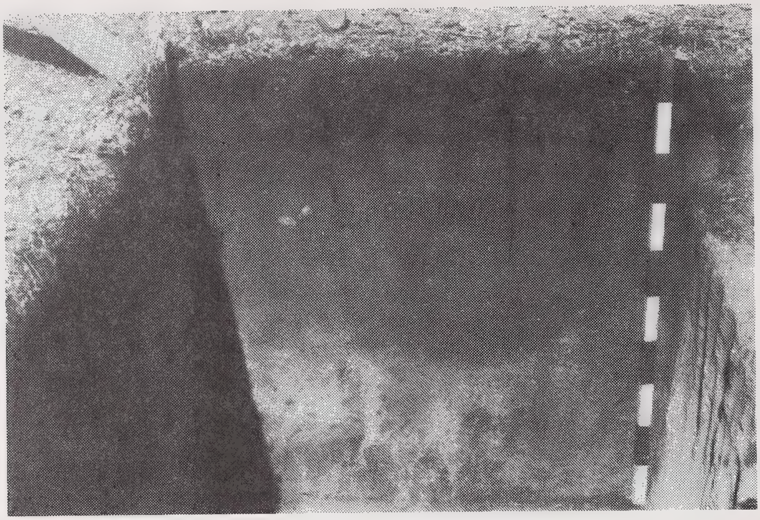

Figure 24: Soil profile in Unit 2, Area 2.

Unit 3

This 2 m^2 test unit was located yet further downslope and away from the main kill site, approximately 300 m to the east (Figure 21). The unit is situated on essentially flat ground immediately adjacent to the spring channel and exhibited thin surficial deposits of bone, FBR and debitage. This unit was selected to help determine the bounds of the processing site deposits and offered an opportunity to evaluate changes in the sedimentary history of the camp/processing area. Unit 3 contained substantially fewer artifactual remains than Units 1 and 2. Not only were there fewer artifacts in this unit, but none occurred below 6 cm in depth and the majority that were recovered were found within the confines of a hearth feature. The indication being that the area is certainly peripheral to the main camp/processing area and was the scene of particularized and isolated activity (Figure 25).

The hearth was denotated by a reddened matrix and associated layer of FBR measuring 28 by 21 cm and extending 6 cm into the subsoil. Another small oxidization stain located 50 cm west of the hearth could not be evaluated as it was largely outside of the excavation unit. There was no

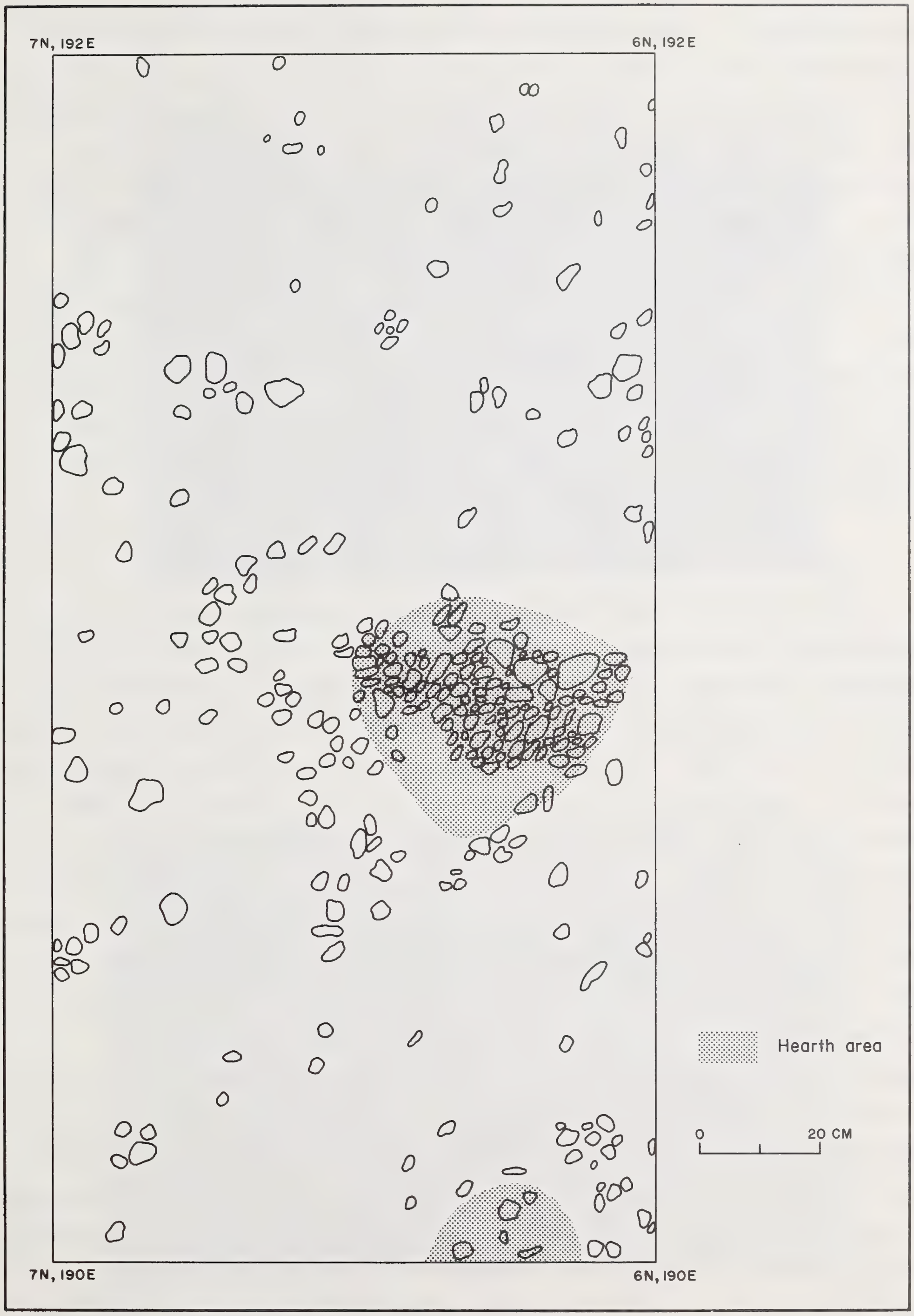

Figure 25: FBR concentration in north 1/2, Unit 3, Area 2, Level 1.

concentration of FBR associated with this second stain, and no artifacts were recovered. The soil profile for the unit exhibited the standard pattern of a shallow Ah, a nearly non-existent B horizon and a massive C horizon development. Layers and pockets of sandstone fragments attest to the long distance movement of colluvium. No cultural remains were recovered in the lower levels of the profile. The lowest level of the Unit 3 excavation reached 70 cm below surface whereupon a possible till horizon was encountered (Figure 26). This represents the only till horizon discovered during the course of the 1983 field season as none were encountered in the backhoe trench excavations completed in Area 1. The age of this till is not known. The identification of this possible till is based on the presence of an abundance of rounded quartzite cobbles contained within the same buff coloured silt matrix of the C horizon.

Unit 4

Previous to the 1983 field season most excavation in the camp/processing area had been restricted to that area of the site which contained the dense deposits of artifacts and features. Although few details are available with respect to the location of these units, it is clear that they were all south of the spring channel on the roughly level prairie at the base of the main kill site. Some contradictions were evident among the various personal accounts of how extensive these deposits were, with reports of cultural material extending to depths of 75 cm and 30 cm depending on the source. Although there was some debate over the maximum depth of the remains there was unanimous agreement on the fact that the deposits were composed of collapsed stratigraphic horizons. It was also noted that the oldest deposits in the camp/processing area, based on diagnostic projectile points, were limited to the Late Prehistoric Period despite the fact that the bone bed deposits indicate discontinuous use for the last 5,500 years. A 2 m^2 excavation unit was placed in the midst of the main camp/processing area (Figure 27 and 21), but situated so as to avoid the numerous depressions that pockmarked the locality. Some of these depressions are squarish in outline and may be former excavation units, while others are irregular and could be the result of pot hunting or rodent activity. It was

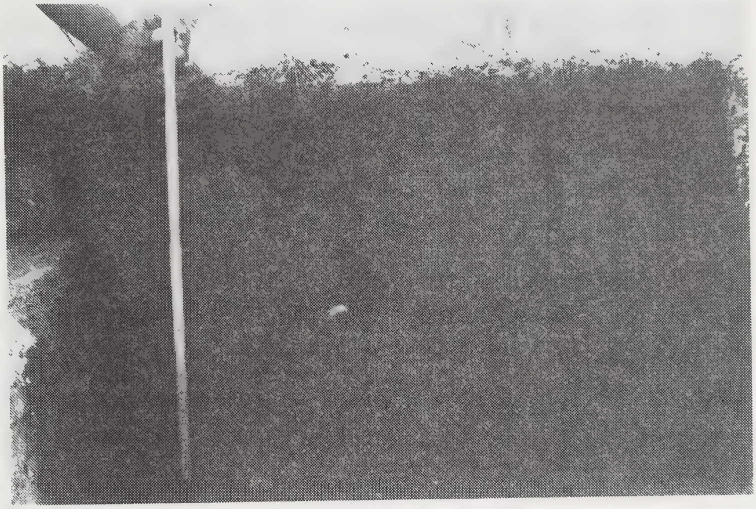

Figure 26: Soil profile in Unit 3, Area 2.

Figure 27: Excavation Unit 4, Area 2.

anticipated that this excavation would provide detailed information on the depth of the deposit, the nature of the collapsed stratigraphic record and an indication of the maximum time depth represented by such deposits. The unit was also intended to provide a comparison between the processing deposits on each side of the spring channel.

The surface of the test square was littered with FBR and small fragments of bone. Excavation proceeded entirely by trowel, grapefruit knife and wisk broom. Owing to the density of the remains the arbitrary 10 cm excavation strategy was modified by establishing multiple layers of bone and FBR within each level. This involved the mapping of each exposed surface of bone and FBR prior to its removal and, then, the exposure of successive layers of bone and stone. In this way it was hoped that the collapsed strata might be detected by the separation of the deposit into a series of arbitrary layers and levels. We found that the use of multiple layers within each 10 cm level was necessary in order to continue our floor plan maps of bone and FBR distribution. That is, the density and superimposed nature of the remains in Unit 4 made it impossible to draw all materials on a single map of a 10 cm level.

No features or obvious concentrations of FBR or bone were noted during the course of the excavations. Instead, the bone and FBR literally paved the entire floor of the unit making recognition of clusters impossible (Figures 28 and 29). There were some areas of the unit which produced more whole bone and discrete deposits of burnt bone and charcoal rich matrices but none were sufficiently distinctive to warrant a feature designation. The bone recovered from this unit was poorly preserved and some large bone required stabilization with dilute white glue prior to removal. The poor bone preservation in this area is felt to be a result of prolonged exposure to weathering and ungulate and human trampling (Behrensmeyer 1978, Miller 1975).

Faunal remains identified from this excavation were predominantly bison but unlike the other units a more complete representation of the carcass was evident in the elements recovered (Table 4). While elements of the lower limbs continued to be numerically superior, there was ample evidence of rib, skull, mandible, and vertebral portions suggesting that more than just quarters were transported to this area of the processing site. In as much as the differential abundance of limb elements may be

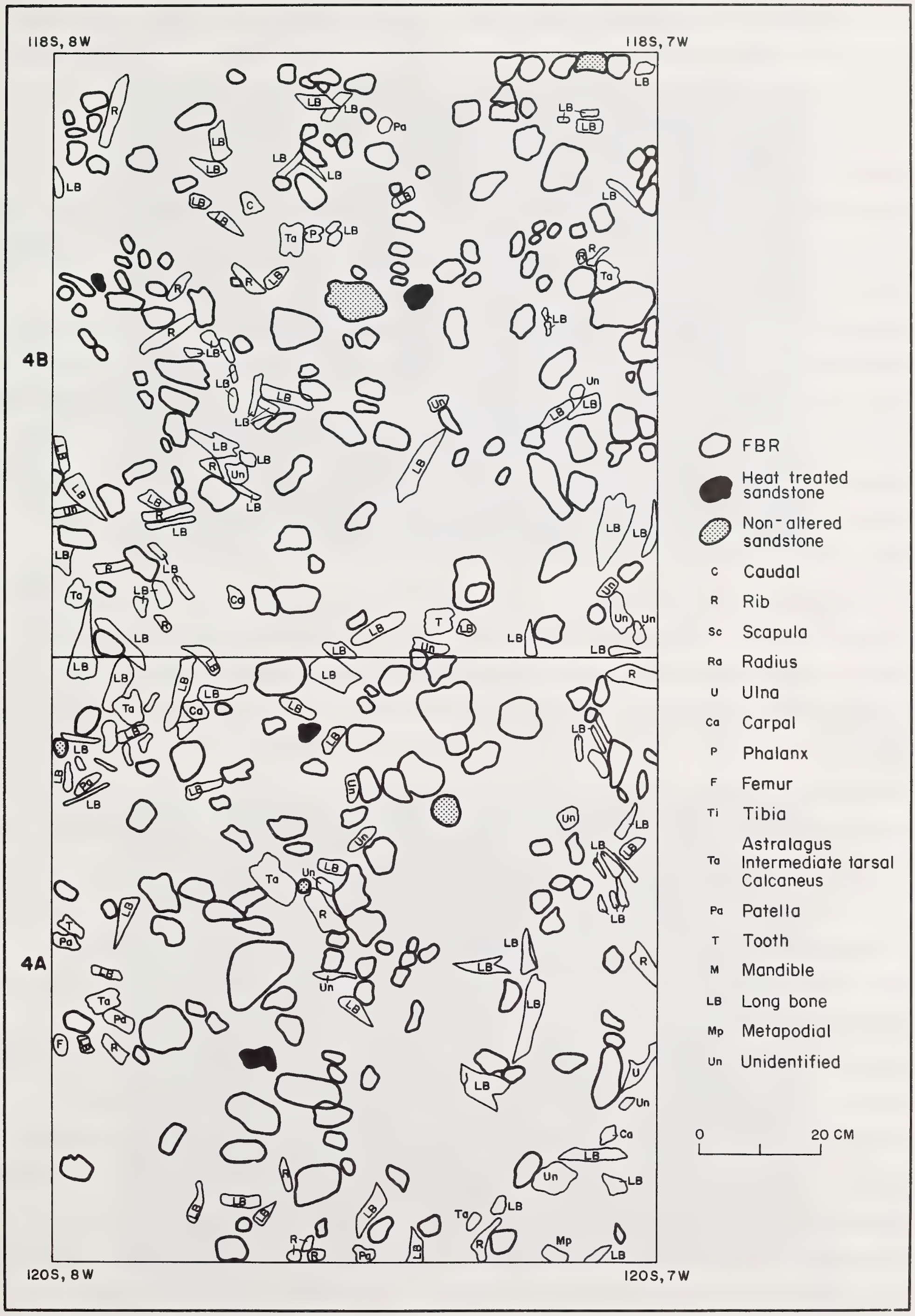

Figure 28: Plan view of Level 2, Layer 1, Unit 4, Area 2.

an artifact of weathering processes, the abundance of cranial and axial skeletal remains may have been much greater immediately after abandonment and prior to destruction of the weaker elements by taphonomic processes. In some instances there were multiple occurrences of a particular element within a single subquad, notably the astragulus and phalanx. The presence of multiple phalanges may be indicative of simple discard of the foot element intact or, alternatively, discard of the individual elements following boiling for glue extraction (Verbicky-Todd 1984). The abundance of lower limb bone elements may be indicative of marrow and grease extraction following removal of the major muscles. Unfortunately the poor faunal preservation makes the identification of bone processing difficult. The bone element portions that would be preferred, and thus destroyed as a consequence of bone grease rendering are also the portions that would be susceptible to taphonomic agencies that destroy bone. A more complete discussion of bone processing and butchering at Head-Smashed-In is provided in the section dealing with faunal remains. It suffices to state here that the kinds of remains present in Unit 4 mark a sharp departure from previous units, both with regard to the density and variety of elements encountered. The presence of multiple mandible portions, abundant tooth fragments and cranial portions is somewhat at odds with the scenario which would see the head and axial skeleton abandoned at the kill site and only quarters transported to the camp/processing site (Wilson 1914).

As noted earlier the distribution of FBR did not reveal any obvious arrangements or concentrations that would be indicative of discrete activity patterning. Anomalies were discovered, however, when the density of FBR was determined for individual subquad units and count/weight ratios were calculated. It appears that the density of FBR varies in both a horizontal and vertical dimension. In vertical dimension the FBR becomes smaller in size with increasing depth below surface, while the horizontal distribution reveals larger pieces of FBR adjacent to the western wall of the unit. There are a variety of explanations that might account for such a distribution, however the area excavated provides insufficient spatial coverage for purposes of evaluating such explanations.

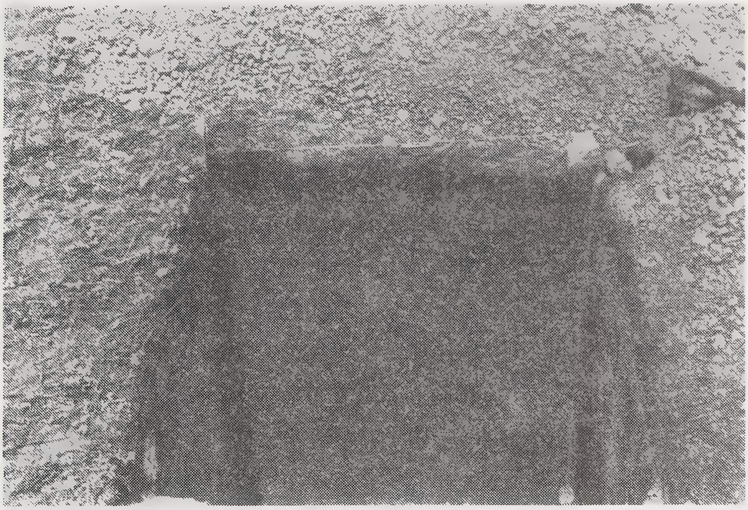

Figure 29: Floor of Unit 4, Level 2, Layer 1, Area 2.

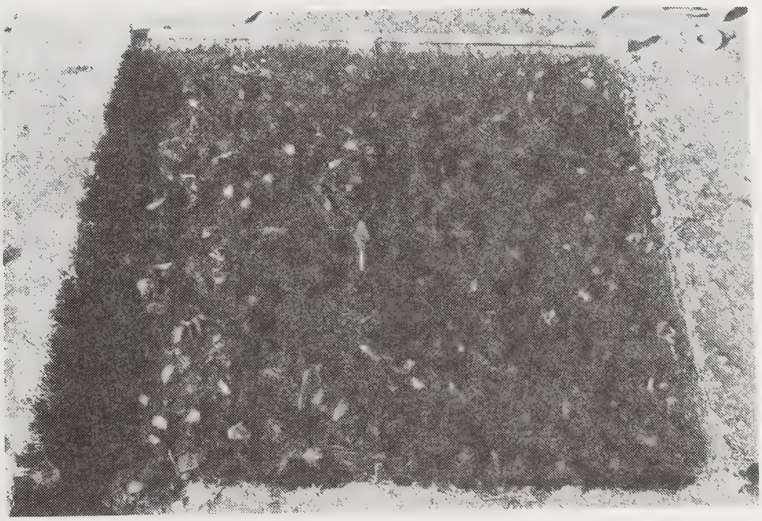

Figure 30: Soil profile in Unit 5, Area 2.

Artifacts recovered from this unit include a large number of small ceramic fragments one of which is a rimsherd. Unfortunately the rim is undecorated and insufficiently complete to speculate on vessel form, or even the rim profile variety, thus making an assignment of time horizon impossible. The ceramic remains were dispersed throughout the unit and no estimate can be offered on the number of vessels represented. Lithics were abundantly represented, with debitage occurring in densities of several hundred pieces in one 10 cm level of a 50 cm subquad. In fact the densities would have been much higher had smaller mesh screening been employed as indicated by the analysis of a column sample from this unit. The interpretive value of such a sample is open to conjecture however, for it is likely that the very small items of debitage have been subjected to sorting and redistribution by wind action subsequent to primary deposition.

The lithic tool kit was largely composed of retouched and utilized flakes with significant numbers of biface fragments, notably projectile points. The assemblage as a whole is consistent with the scenario of local repair and replacement of broken projectiles combined with the manufacture of tools for use in the processing of bison. In general the tool kit is supportive of the hypothesis of Reher and Frison (1980) that large communal kill sites will display a lithic assemblage characterized by an abundance of finished tools and resharpening detritus and low amounts of primary manufacture remains. The rationale for the hypothesis is that the events were well planned in advance, thus allowing the hunters to "gear up" with the necessary tool kit and reducing the need for on-site tool manufacture. The exception to this prediction is the abundance of bipolar cores found in the processing area, especially in Unit 4. These artifacts and their possible function will be discussed in greater detail in the lithics section of the report. The lithic raw materials represented in this unit originate from a variety of distant quarry sites located in Montana, Wyoming, British Columbia, North Dakota and Alberta (see discussion in section on lithics).

Unfortunately there was insufficient time available to excavate Unit 4 to sterile substrate and a continuous soil profile was not exposed. At the end of the 1983 season the floor of the unit (about 20 cm below surface) was covered with plastic and filled with dirt. The maximum depth of the deposit in this unit was determined on the basis of a column sample extracted from the southwest corner of the unit. The deposit was composed of a homogeneous mass of FBR, bone and humic soil to a depth of 30 cm below surface where sterile substrate was encountered.

Unit 5

This 1 x 2 m unit was located on the north side of the spring channel just at the base of the toe of the slope leading up to the main kill deposits (Figure 21). As such the unit is situated on fairly steeply sloping ground. The placement of this unit at the toe of the slope was done intentionally in an attempt to find an area of the site which might display sedimentary stratigraphy. Excavation of Units 1, 2 and 3 had demonstrated a decrease in the depth of cultural material as distance from the slump blocks increased. This is due, no doubt, to the differential deposition of slump, colluvium, loess, and sheet wash deposits in the areas closest to the cliff face. Continuing further upslope should theoretically produce yet greater amounts of deposition and thus increase our chances of encountering buried and stratified occupation layers. The trade off in exploring this possibility, however, is the necessity of digging on fairly steeply sloping ground surface, an exercise which our excavations in Area 1 had indicated had little potential for discovering cultural materials.

There were several large sandstone fragments noted on the units surface but remarkably few items of FBR or bone fragments were present. The unit was oriented with its long axis running north/south perpendicular to the one in eight local slope. Our hopes for buried and stratified cultural materials were not fulfilled, as Unit 5 turned out to be the least productive of all excavations in Area 2. A total of only 35 pieces of FBR were recovered, the majority of which clustered near the southeast corner of the unit, coincident with the three identifiable bones from the unit (Table 4). The cultural deposits were sparsely distributed and did not extend beyond the first 10 cm level below surface. The results were generally similar to those encountered in Unit 3 which, it will be recalled, was placed quite distant from the main bone bed. In the case of Unit 5 we believe the lack of cultural material is a factor of the degree of slope to the area.

The northern wall of Unit 5 was selected for a soil profile and excavated to a depth of 1.1 m. The upper soil horizons were very thin and compressed into the first 8 cm below surface. The remainder of the profile revealed a massive C horizon composed of compact silts, sands and some clay, with sandstone fragments and small pebbles dispersed throughout but concentrated between 80 cm and 110 cm below surface (Figure 30). The absence of large sandstone fragments in such close proximity to the eroding cliff face is curious, but may be explained by the isolated nature of downslope movements of sandstone debris. There were no indications of deeply buried remains and the area is considered to be peripheral to the main camp/processing area on the basis of the excavation results.

Unit 6/21

This unit was located on the south side of the spring channel in the same area of the camp/processing site as Unit 4 (Figure 21). The unit location marked the highest point in this area of the camp/processing site and overlooked the 5 m deep spring channel. The area excavated was originally 1 x 2 m in size and was designated as Unit 6. Subsequent to the discovery of a large feature in the southern portion of the unit a 1 m^2 extension was added to expose the feature, this being designated Unit 21. The intervening numbers designate a series of test excavation units set up in association with our testing in the spring channel.

The site surface in the vicinity of Unit 6/21 was littered with FBR and bone fragments much in the same way as Unit 4. There was however much more evidence of subsurface disturbance in the form of depressions which were often partially infilled with FBR and recent debris. It is probable that a nearly square depression immediately south of the unit is one of the test excavations completed nearly two decades ago during Reeves' excavations (Ron Getty pers. comm.). Including the extension this unit measured 1 x 3 m and was oriented with the long axis running north/south (Figure 21).

The initial 5 to 6 cm of the deposit was a homogeneous, compact mass of FBR, bone and lithic remains in a matrix of dark sandy silt. Below 6 cm the northernmost 1 m^2 became rapidly sterile. Aside from a few remains introduced by the collapse and infilling of rodent burrows this northern 1 m^2 square was sterile after the completion of the first arbitrary level. The situation in the other two squares differed markedly. After the removal of the first 6 cm of the deposit the amount and size of bone and FBR specimens increased and began to define the plan form of a large circular pit feature. Unlike the bone which had characterized the upper 6 cm of the deposit, the more deeply buried bone elements within the pit feature were in good condition, were largely complete, and revealed little surface weathering. It is notable that after only a few days exposure the surface of the bone began to develop the characteristic fracture lines associated with the weathering of fresh bone (Behrensmeyer 1978, Miller 1975).

The pit feature measured 90 cm in diameter and had a maximum depth below surface of 50 cm. The complete description of this feature is presented elsewhere in this report, it suffices here to note that two periods of use are indicated by the layered fill of the feature. An upper fill layer was densely packed with FBR and large, well preserved bison bone elements. A lower fill layer contained a lighter colour soil and considerably less bone and FBR. The size of the feature prompted speculation that this was a boiling pit known to have been used ethnohistorically for the cooking of meat and rendering of bone grease (Wissler 1910). The contents of the feature contradicted such an evaluation however, as the skeletal elements present were not representative of the type or size of bone that one would anticipate in a boiling pit (Losey 1972, Dyck 1977, Leechman 1951). There is a very good possibility that the feature was employed for the purpose of bone boiling but that the feature fill is the result of camp refuse falling into the pit subsequent to abandonment. The fact that the feature matrix reveals two episodes of infilling strongly suggests that campsite and processing activities rather that the original feature function are represented by the pit contents. In addition to the normal complement of FBR, bison bone and artifacts the detailed analysis of the feature fill revealed ample evidence of small mammal remains which may have been introduced naturally to the pit fill. Also several vertebra from an unidentified species of fish were recovered from the feature fill. These were obviously brought to the site by the prehistoric occupants but may, or may not, have been originally associated with the feature. The presence of fish is notable in this context and it is interesting to observe that several pieces of bivalve shell were recorded in the camp/ processing area. Presumably both the fish and bivalve specimens were derived from the nearby Oldman River which continues to support a variety of fish and bivalve species. Earlier in this century the Piegan operated a fish weir on the Oldman River with great success (Edward Yellowhorn, pers. comm.).

The features in the camp/processing site area are an important adjunct to the compressed and intricate prehistoric record that is preserved in the shallow but dense deposits of FBR, bone artifacts and loess which cover much of the site area. Feature contents are notably better preserved than their counterparts in the areas containing collapsed deposits. They are representative of a restricted period of activity in the sense that a specific use of the site is reflected by the remains and that the nature of these subsoil facilities provides an indication of the postkill processing activities. It is interesting to note that most of the oral accounts pertaining to the historic hunting of bison by Plains Indians end abruptly after the kill. The activities which consumed the majority of the people's efforts and time are really quite imperfectly understood (ie. the processing and stockpiling of bison by-products). The features at HSI provide a rare source of data that retains some contextual integrity, that reflects specific episodes of site use and that provide clues to the complex activities which people engaged in to ensure that the vast quantities of bison were adequately utilized following the successful killing of a herd.

SHOVEL TESTS

Two shovel test excavations were completed in the camp/processing area and these were initiated at the close of the field season. The purpose of conducting these tests, which were located 20 and 40 m south of excavation Unit 4 (Figure 21), was to determine the continuity of the deposits reported by Reeves (pers. comm.) with those observed by us in excavation Unit 4. Since we had received verbal reports of cultural materials extending to depths of 75 cm or more in the vicinity of Unit 4 and since we were unable to complete Unit 4 in the 1983 season, we decided to quickly excavate two 50 cm^2 shovel tests in order to establish the maximum depth of cultural deposits in this area. The reason the two units were placed to the south of Unit 4 was because it was in this direction (about 50 m south of Unit 4) that Reeves had conducted his most extensive excavations in the camp/processing area (Reeves, Getty, pers. comm.). All of our 1983 excavations in Area 2 (the main camp/processing area) had indicated that cultural materials terminate between 10-30 cm below surface (with the exception of subsurface pit features). Obviously we considered it important to know whether or not some part of the processing area contained materials at over twice that depth. The two shovel tests were seen as a quick means of obtaining this information.

Shovel test one revealed dense cultural deposits to 20 cm below surface where sterile deposits of light brown silty soil began. The second more southerly shovel test exhibited dense deposits to 30 cm below surface at which depth the light brown silt interface was encountered. As before rodent burrows were noted and have resulted in the downward movement of some items but these are readily distinguishable. The shovel test nearest to Unit 4 revealed the partial profile of a pit feature in its east wall, consisting of a basin shaped deposit of calcined bone, FBR, and sandstone fragments in an upper matrix of light coloured ash-like material that changed to a dark mottled matrix at 17 cm below surface and extended to 30 cm below surface.

Neither of the two shovel tests supports the information supplied to us by Reeves and Getty regarding the depth of cultural material in this area. We have no explanation at the present time as to why our excavation results differ quite dramatically from the recollections of individuals who have previously worked at the site.

SUMMARY OF EXCAVATIONS IN AREA 2

In summary, the second major part of our initial season at Head-Smashed-In Buffalo Jump consisted of a test of the camp/processing site deposits situated on the prairie level below the sandstone escarpments and adjacent slump blocks. The decision to test this area was motivated by several factors: 1) the realization that due to the previous studies of the deep, stratified bone bed and due to the UNESCO designation of the site, it would be unlikely for additional studies of the bone bed to be permitted; 2) the fact that very little was known about the bison processing events at HSI and, for that matter, at Plains communal kill sites in general; 3) the planned construction of an interpretive facility at HSI necessitated the generation of additional information on the site and on processing activities so as to enhance the interpretive storyline presented in the Visitor Reception Centre.

Once it was determined that any time and resources not consumed by our mitigative archaeological responsibilities would be devoted to the processing area of the site we proceeded to formulate a number of objectives for research related excavations. Given the infancy of our archaeological program at HSI and the nearly complete lack of information on the archaeological record of the processing area, the objectives for the 1983 season were necessarily of a fact-finding nature. More than anything else we simply wanted to know the age, nature and extent of the cultural materials situated below the jump so that specific research questions could be formulated in subsequent seasons. Tests were designed to be widespread, covering a large area of the site and exploring a range of topographic and depositional situations. We wanted to know about the number and kind of artifacts present; the condition and element representation of the fauna; the presence, absence and integrity of site features; the age of various occupations as indicated by diagnostic artifacts and radiocarbon dates; and especially about the possibility of encountering stratified deposits somewhere within the area where bison processing took place.

Our exploration of the processing area was conducted with seven excavation units (#1-6, 21) and two shovel tests, all of which were spaced fairly far apart so as to test a wide area of the site. Including the shovel tests, a total of $12m^2$ was excavated on the north side of the spring channel, and 7.5 m^2 on the south side. Excavation utilized careful recovery techniques as necessitated by the great density and fragile nature of the bone which characterized the upper levels of most units. All units contained varying amounts of bone, FBR and flaked stone, with some units also producing pottery, hearths, other features, shell, ground stone and historic materials. The most productive units were 1 and 4 which are located about parallel to each other in terms of their relation to the cliff face. The least productive units were 3 and 5; the former being located the greatest distance away from the kill site, and the latter being the closest to the kill but situated on the greatest slope of all the units.

In our estimation the "core" of the processing area is contained within an area of at least 10,000 m^2 on the north side of the spring channel, and 25,000 m^2 on the south side (Figure 27). These estimates are based in part on the results of our walking survey. It is also clear, however, that beyond this "core" area cultural materials extend for tens of thousands of additional square metres especially to the north and southwest in a belt paralleling the sandstone escarpment. These more peripheral areas were not tested and their relationship to the killing and butchering of bison at HSI is not known. The indications from our excavations in Area 2 and the mitigative work in Areas 1, 11 and 12 are that these more peripheral areas are characterized by near surface deposits of bone, FBR, and flaked stone material very similar to that of the core processing area but far less dense and in lower frequencies. For the time being we are assuming that these peripheral areas also represent the conduct of prehistoric activities associated with the use of the jump. However, the possibility that they represent occupations which are essentially unrelated to HSI cannot be ruled out.

The research directed excavations in Area 2 have provided us with a reasonable indication of the materials present in the main processing area. These can best be described as a veritable pavement of bison bones on FBR with a lithic assemblage dominated by debitage, retouched flakes and formed tools, especially points. As expected the bone is overwhelmingly bison, with some small mammal, fish, bird and other large and medium-sized mammals represented in small percentages. The bone was in a poor state of preservation with the exception of pit feature contents. Many of the larger elements uncovered began to disintegrate into small fragments during recovery and identification. Many times an element identifiable when first encountered in the units was unrecognizable by the time the specimens were unwrapped in our field lab. This fact emphasized the need for *in situ* identification. More than anything else the faunal assemblage was dominated by tiny fragments of bone, many of them obviously from long bones or ribs. All bones retained in the 1/4" screen (6.3 mm) were saved, and considerable effort in our analysis of the 1983 results has focussed on the origin and meaning of these data. The initial tendency to attribute the fragmented fauna to intentional bone processing must be tempered by the obvious and severe taphonomic agencies which played havoc on the shallowly buried materials. This problem will be discussed at some length in another section of the report.

Unfortunately, no areas investigated by us in 1983 were characterized by stratified cultural deposits, or even by layering through vertical space which could be argued to be separable cultural components. This compression of the archaeological record spanning several thousands of years into a few centimetres of soil is going to create major problems in interpreting the events and processes of bison rendering at HSI. A few possible means to alleviate this situation will be discussed in the final section of the report dealing with future directions for research at HSI.

SECTION FOUR

ANALYSIS OF MATERIAL REMAINS

LITHICS

Introduction

The lithic assemblage recovered during the 1983 season at Head-Smashed-In consists of 14,207 flaked stone artifacts and associated debitage and 11 ground stone or unmodified stone tools. The flaked stone assemblage is comprised of 13,468 pieces of debitage, 156 cores, and 583 tools and tool fragments including 167 projectile points. In this section of the report a basic lithic analysis of these materials is presented. This analysis is again tempered by the same constraints which pertain to all the data recovered from the 1983 season at Head-Smashed-In; namely the general paucity of deposition and lack of stratigraphy in the processing area, and the widespread and multipurpose nature of our excavation strategy. As a result of these factors we have few areas of sizeable, contiguous excavations, and virtually no natural stratigraphic or cultural separation of the data.

These extenuating circumstances greatly inhibit the application of our analyses to problems and topics of interest to Plains archaeologists. The approach adopted here is a primarily descriptive report of the recovered lithic material, giving the greatest detail and discussion to the projectile points which are generally regarded as the most important lithic artifact at Plains archaeological sites. Importantly, however, we have also decided to take this opportunity to present the details of a comprehensive lithic analysis methodology which we anticipate using for several subsequent seasons at Head-Smashed-In. This methodology is presented in Appendix 2. While not an exhaustive treatment of metric and non-metric attributes of stone tools, it is an intensive treatment of the subject, emphasizing the quantifiable aspects of a lithic assemblage. This, and the detailed method of projectile point analyis, are intentional and reflect our belief that Plains archaeology, and especially Plains point typology, are in a chaotic state. Point types proliferate upon other types, sub-types, variants, and so on. Indeed, it would be difficult to concoct a field of science less rigorous than contemporary stone tool typology. Our own methodology detailed herein makes no pretence to remedy all these difficulties, but we do assert that it is comprehensive and explicit. We believe that, given time, the consistent application of objective stone tool descriptions, coupled with relevant subjective assessments, may eventually permit confident and quantifiable ordering of stone tool data upon which testable assumptions or hypotheses may then be based. It is encouraging to note that in-house experiments having different staff apply the analytical procedures outlined in Appendix 2 to the same tool set yielded nearly identical results.

Given the depositional and sampling constraints noted above this first report is necessarily descriptive in nature, and will treat the entire 1983 lithic assemblage as a whole. That is, since over 99% of the lithics were recovered from the upper 20 cm of a compressed and manifestly disturbed soil horizon no attempt will be made to isolate and analyze separately, arbitrary divisions of the assemblage. It should be noted, however, that the great bulk of the recovered lithics (74%) were derived from the handful of excavation units (1-6, 21 and shovel tests 1 & 2) placed in the most productive area of the site - Area 2, the core of the processing area. Thus the following analysis pertains primarily to the data from this region. In contrast, lithics recovered from all excavations in Area 1 totalled 2050 (14.4%), in Area 11, 1603 for 11.3% of the total assemblage; and in Area 12, 36 or 0.3 % of the assemblage.

The following analysis proceeds according to the order of categories identified and defined in Appendix 2 and serious readers are urged to consult this document before proceeding further.

Debitage

A total of 13,468 pieces of lithic debitage were recovered from the various excavation units, shovel test pits, and auger tests conducted at Head-Smashed-In during the 1983 field season. This constitutes 95% of the entire lithic assemblage. Twenty different raw material types have been identified, however because of the scarcity of certain lithic types, and because of the closely related nature of several materials, these 20 types have been grouped in 8 gross textural categories (Figure 31) to facilitate interpretation. Microcrystalline silicates (cherts, chalcedonies) numerically dominate the assemblage (60.6%) and represent almost a third (31.7%) of the assemblage by weight. Quartzite is the second most prevalent numerically (18.6%) but represents the largest relative mass (41.4%). Fine grained silicified sediments are well represented (8.7%, 6.1% by weight), and fewer amounts of fine grained nonsilicified materials, silicified wood, sandstone, obsidian, and quartz crystal occur respectively. The full list of counts and percentages for the various debitage raw material types is presented in Table 5.

No detailed petrographic source analysis was undertaken but from our own observation it is evident that the majority of raw material types represented at Head-Smashed-In are derived from relatively local sources; that is, the major river and creek valleys southern Alberta. The glacial till, best exposed in the regional river valleys, offers a variety of small chert pebbles, mudstones, siltstones, and fine grained sandstones. Of the microcrystalline silicates, Swan River chert was observed to be the most prevalent variety. This material has a wide distribution on the Canadian plains (Campling 1980), although its occurrence in Alberta is probably restricted to the limits of Laurentide till (John Brumley, pers. comm). Most of the larger debitage was derived from quartzite or green argillaceous sandstone cobbles available in local river gravels. Materials from bedrock outcrops in the Canadian Rockies are also represented. No glacial till, or other source of quality lithics, has yet been detected at the site itself and given the poor flaking qualities of the local sandstone bedrock, it appears that virtually all flaked stone has been brought to the site.

While much of the debitage is from regional sources, more distant, exotic sources are also well represented. We have adopted a conservative approach in attempting to identify source areas, or "type sites", for these exotics due to what we feel are inadequacies in the existing source information. For example, we believe that fine quality cherts from numerous known quarries in the Madison Formation of Montana are present in the H.S.I. assemblage, but the inter and intra-quarry variability of these cherts makes them exceedingly difficult to identify (J. Brumley, pers. comm.). Obsidian, presumed to be from the Yellowstone quarries, is represented by 263 small items. Knife River Flint is certainly present,

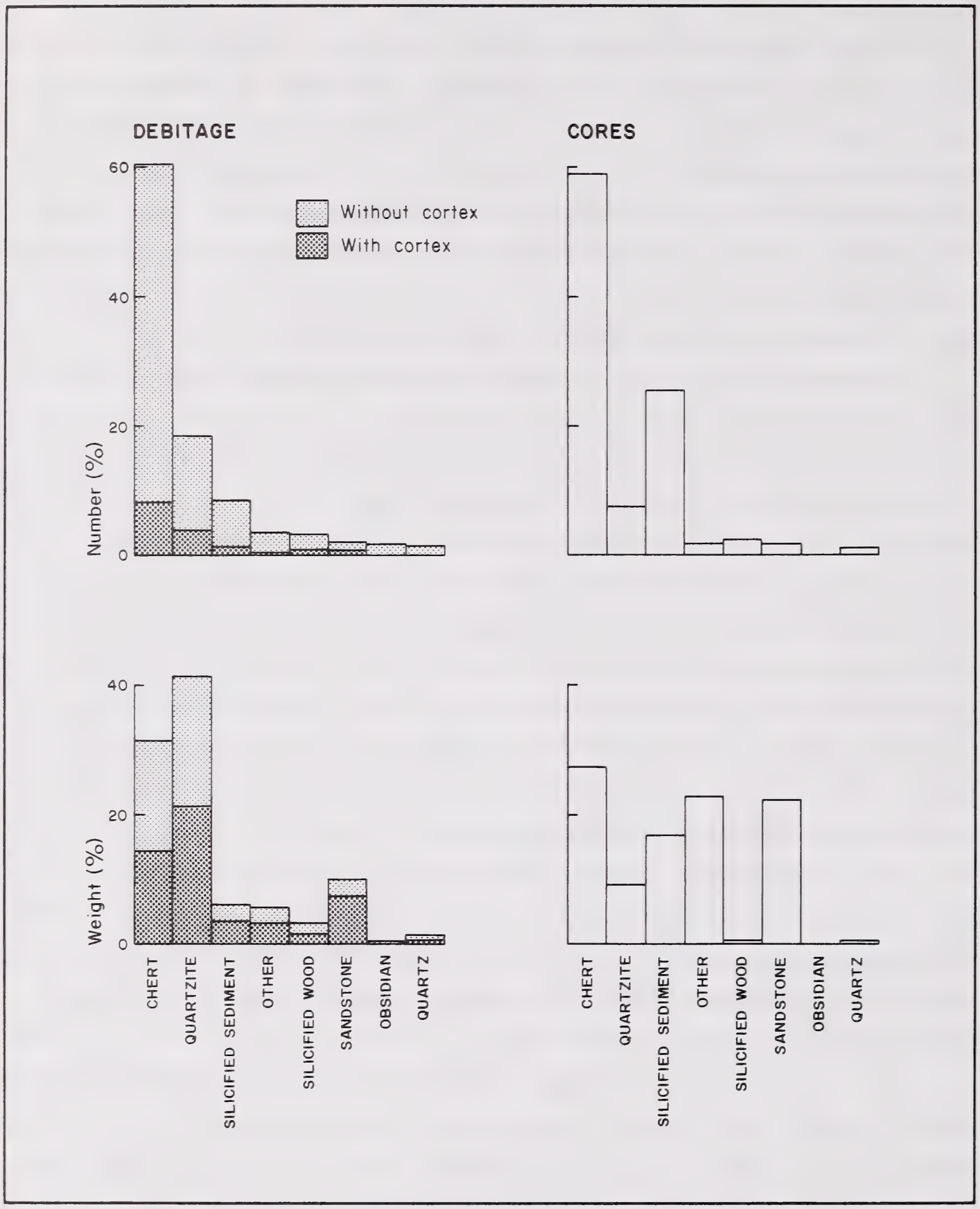

Figure 31: Relative frequencies of raw material of debitage and cores. CHERT includes cherts and chalcedonies; SILICIFIED SEDIMENT includes silicified siltstone, silicified mudstone, silicified sandstone, fused glass, porcellanite, and silicified peat; OTHER includes basalt, argillite, mudstone, siltstone, and unidentified materials.

Table 5: Frequency of Raw Materials Represented in Debitage.

Raw Material	No. of Pieces	%	Total Weight (gm)	%
Chert	5779	42.9	1,740.7	26.3
Chalcedony	2384	17.7	357.0	5.4
Quartzite	2510	18.6	2,733.5	41.4
Silicified Siltstone	744	5.5	229.7	3.5
Petrified Wood	450	3.3	214.8	3.2
Silicified Mudstone	368	2.7	130.8	2.0
Siltstone	299	2.2	217.2	3.3
Sandstone	270	2.0	664.2	10.0
Obsidian	263	1.9	17.5	0.3
Quartz	191	1.4	99.5	1.5
Argillite	83	0.6	99.7	1.5
Silicified Sandstone	79	0.6	50.3	0.8
Porcellanite	14	0.1	01.3	0.2
Limestone	11	0.08	31.6	0.5
Mudstone	8	0.06	7.0	0.1
Basalt	5	0.04	2.5	0.04
Silicified Peat	2	0.01	0.9	0.01
Fused Glass	1	0.01	0.6	0.01
Unidentified fine	5	0.04	1.0	0.02
Unidentified coarse	2	0.01	0.9	0.01
TOTAL	13,468		6,609.8	

though exact counts of this material are hampered by the absence of the distinctive silicified organic inclusions characteristic of K.R.F. (Clayton et. al. 1970). The very small size of most of our debitage probably accounts for the inability to recognize these distinctive inclusions in many pieces of K.R.F. Other exotic lithics included fourteen items of a gray porcellanite, and one item of fused glass - both of which are available in Montana and Northern Wyoming (Fredlund 1976).

The debitage analysis was kept simple by recording only the raw material type, the weight, the presence or absence of a cortical surface, and the relative size using the size square method detailed in Appendix 2. For the purposes of this analysis, distinctions were not made between whole flakes, flake fragments and shatter. Although this procedure undoubtedly biased the results toward a higher proportion of smaller items, it was observed that most of these, including even the smallest pieces, were largely intact flakes. The debitage was predominantly small thin finishing or resharpening flakes. This small size is indicated by the fact that seventy one percent of all the pieces of debitage can fit into a size square measuring 10 mm on a side. The smaller flakes are almost exclusively very fine grained, often exotic, raw materials, which correlate with a similarly large proportion of small finished artifacts of the same materials in the tool assemblage. A similar correlation is not evident however with artifacts made of coarser materials. There are several hundred large flakes of quartzites and argillaceous sandstones, which appear to have been struck from large bifaces, but only a handful of fragments of these tools are present. The lack of large butchering tools in the processing area is surprising and we can only speculate at this time that these tools were either curated or were used and discarded elsewhere, perhaps at the kill site itself.

Although the debitage is characterized by a high incidence of finishing or resharpening flakes, all stages of lithic reduction are represented. Flakes bearing a cortical surface represent 16.2% of the debitage sample and represent 52.7% by weight. Most of the debitage (74.3%) was recovered from the research area (Area 2) adjacent to the kill site. This material was compared to that recovered from the development area of the site (Area 1) to determine if any intrasite variability in the debitage could be detected. Relative proportions of raw materials were similar as were the relative numbers of cortical to non-cortical flakes. An examination of the mean weights of the two major lithic categories showed that slight interareal discrepancies existed. A plot of the size frequencies of the cortical and non-cortical flakes from each of these two lithic categories, microcrystalline silicates (or "chert") and quartzite (Figure 32), shows that among the microcrystalline debitage having no cortex there is a significantly higher proportion of the smallest size debitage from the southern end of the site. This tendency is also expressed to a lesser extent in the quartzite component. Microcrystalline silicates and quartzite debitage with cortex show a different size distribution. In Area 1 there is a good representation of the smaller fraction and a rapid drop off after sizes 15 and 20 for chert and quartzite respectively. In Area 2 however, the distribution is more uniform. These results might indicate that either resharpening or finishing of smaller tools was relatively more prevalent in Area 1, and perhaps that in Area 2 either the average size of tool being finished or reworked was larger than in Area 1, or that the complete reduction sequence was better represented. The impact of these interpretations is tempered somewhat with the reminder that this is a multicomponent assemblage and no hard and fast rules for site useage need apply. The evidence does suggest that intrasite activity patterning may be indicated by the distribution and nature of the debitage.

Although no attempt to "type" the debitage was undertaken, a few flake fragments recovered from Unit 6/21 near the spring channel (Figure 21), were observed to bear marked similarities to microblades and would probably be classified as microblades if they were recovered from a microblade site. Two quite dissimilar proximal ends are particularly interesting (Figure 33). Both are parallel sided with three longitudinally trending parallel sided dorsal flake scars forming an expanding trapezoidal transverse cross section. One (Figure 33 a) is a dark gray siliceous mudstone with a single faceted elliptical platform forming a 100^{o} angle with the juncture of the ventral face. At the proximal end of the dorsal face several minute step terminated longitudinally trending flake scars extend distally from the platform. The dorsal-platform edge has been lightly ground parallel to the longitudinal axis. This artifact measures 9.8 mm long (incomplete),

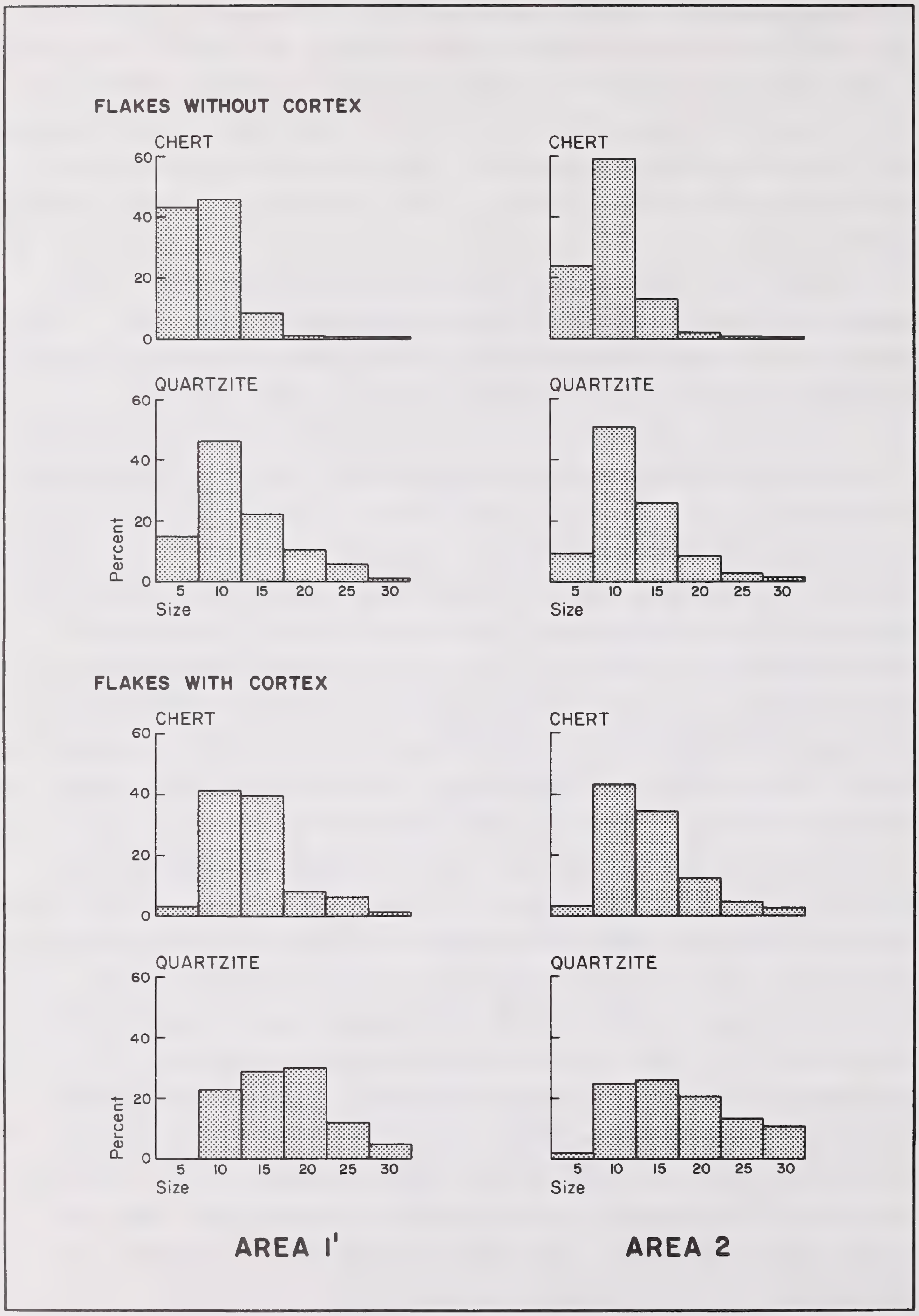

Figure 32: Comparison of chert and quartzite debitage in 5 mm to 30 mm size range.

5.5 mm wide, 1.6 mm thick, and has a platform measuring 2.0 mm wide and 1.0 mm thick. The other specimen (Figure 33 b), is dissimilar in that it lacks the dorsal face battering and, although the platform is partly snapped off, on the intact portion of the platform minute parallel flake scars are visible extending across the platform at right angles to the long axis. One lateral edge of this specimen, which is made of a brown chalcedony, has nibbling retouch. This artifact is 7.3 mm long (incomplete), 4.7 mm wide, and 1.2 mm thick. The ventral face - platform angle is about 110^{0}. Microblades have been recorded from High River (Sanger 1968) which is about 100 kilometers north of Head-Smashed-In. The High River microblades, made of both obsidian and chalcedony, are similar to the siliceous mudstone flake described. No blade cores of any kind, microcore ridge flakes, or microcore tablets were observed in this assemblage despite an intensive scrutiny of the material. Until such artifacts or other microblades are recovered, the recognition of a microblade industry at Head-Smashed-In will have to remain a tantalizing possibility.

Cores

A total of 156 cores are represented in the assemblage. Of these, 135 (86.5%) are bipolar cores, 8 (5.1%) are simple single platform pebble or cobble cores flaked on one face, and 10 (6.4%) are amorphous multiple platform cores. Three core fragments could not be classified into any of these categories as platforms were either missing or were indistinct. Most of the cores (125 or 80.1%) were recovered from Area 2, including 55 from a single 2 m^2 unit (Unit 4).

1) Bipolar Cores (Figure 34) n=135

These cores have been impacted on one platform while the opposing end was supported on an anvil. Often primary flakes are derived from both ends, and both ends are typically crushed. Bipolar cores are distinguished from their byproducts here by the presence of either: a) two opposing crushed platforms, or, b) one platform from which two or more flake scars radiate longitudinally from a common impact locus. Where two or more adjoining fragments of the same core exhibit either of these characteristics, they are analyzed as a single core. The bipolar cores

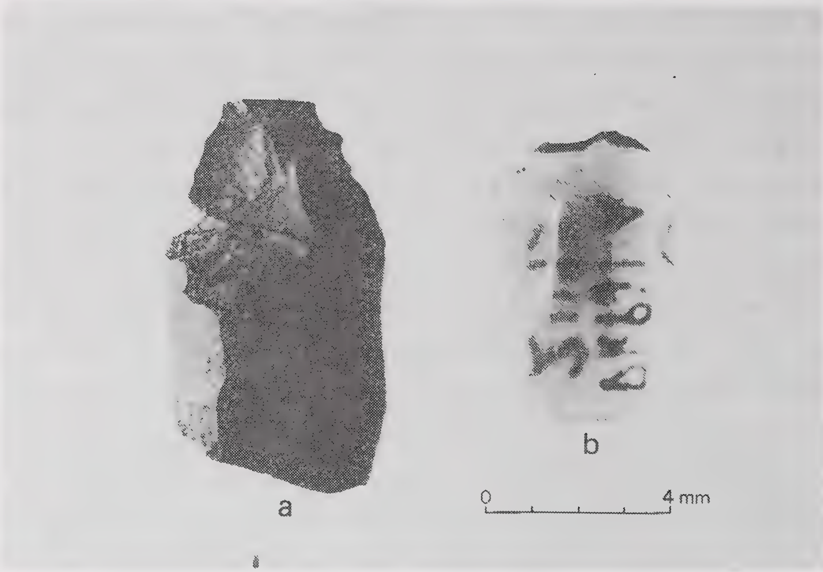

Figure 33: Detail of possible microblades.

Figure 34: Bipolar cores.

recovered from Head-Smashed-In are characteristically small bipolar split elongate and often flattish pebbles ranging from 10 mm to 72 mm in length, with the average length about 25 mm and the average weight of 4.7 gm. Eighty-three (61.5%) of the bipolar cores were impacted at one locus. The preferred orientation of the impaction is along the long axis. On 50 (37%) cores a second bipolar axis was utilized, usually oriented between 45^{o} and 90^{o} from the initial axis, and in two instances a third axis was utilized for a bipolar impaction. The resultant primary flake scars often extend the length of the core, and on one third of the bipolar cores this primary flaking has completely removed the cortex. One hundred and twenty one (90%) of the bipolar cores exhibit no evidence of further use and were discarded, occasionally found with associated debitage byproducts. Fourteen bipolar core remnants show indications of utilization, most often a lateral edge section with smoothening and minute nibbling retouch (n=7), nibbling retouch (n=4), edge rounding (n=2), and in one instance an edge is crushed. Apart from this latter case, use wear appears associated with scraping or shaving functions. In addition to the bipolar cores described above, at least 30 others provided the blanks for the production of formed tools discussed in other sections. Raw materials represented in the bipolar core category are distributed as follows: 85 (63%) are cherts or chalcedonies; 36 (26.7%) are fine grained silicified sediments; 7 (5.2%) are quartzite; 4 (3%) are silicified wood; 2 are of quartz and one is a siltstone.

2) Simple Pebble or Cobble Cores (Figures 35, 36 a) n=8

These cores are pebbles or cobbles which have been struck undirectionally on a single platform, removing flakes from one face. Biproducts struck from these cores would characteristically have cortex platforms. These cores range in length from 38 mm to 91 mm in length, with a mean weight of 91 grams. The angles formed between the cortex platforms and the negative flake scars vary between 52^{o} and 90^{o}, with the average angle at about 74^{o}. Three of these cores are pebble cherts, two of which have been extensively flaked, the third has only two flake detachments. The edge formed by the platform on one of the extensively flaked pebbles has minute nibbling retouch and is smoothened indicating use. Three cores are sandstone cobbles, two of which have been extensively flaked. The cortex surface on one of these latter has been used subsequently as an anvil and is deeply pitted (Figure 36). One core is of quartzite, and has a single flake scar. The other core in this category is a firebroken silicified peat core fragment which has only one remnant flake scar but a sharp steep angled edge formed by the juncture of a thermally related fracture and an adjoining cortical surface has been minutely nibbled suggestive of use on a hard substance.

3) Amorphous Multiple Platform Cores n=10

These cores have two or more platforms and two or more flaking orientations. They range in length from 26 mm to 124 mm, with a mean length of 60.8 mm and an average weight of 101.5 grams. The angle formed between the platform and the negative flake scars average 80^{o}. Each of these cores has been extensively flaked. In four instances a pebble was initially broken in the bipolar fashion and a resultant facet was used as a platform for subsequent detachments. Of these, two are chert, one is a siltstone, and one is quartzite. One of the two chert specimens was impacted by the bipolar technique in three different orientations. Of the other six cores, each pebble was opened up by free flaking on a single cortical surface and the resultant facets were then used as platforms to further reduce the core. Three of these are fine grained silicified sediments, one is quartzite, one is siltstone, and one is chert. This chert specimen (Figure 36,c) was flaked in at least four different directions, although the bipolar technique was apparently not used. None of these multidirectional, multiplatform cores have evidence of usage.

4) Other Cores n=3

Three fragments of cores recovered include: one small chalcedony pebble fragment weighing 3.2 grams, which is a platform end only, probably a bipolar split pebble which was subsequently flaked; one small truncated core fragment of quartzite, weighing 4.2 grams, which has a single faceted platform; and a quartzite spall core weighing 7.2 grams.

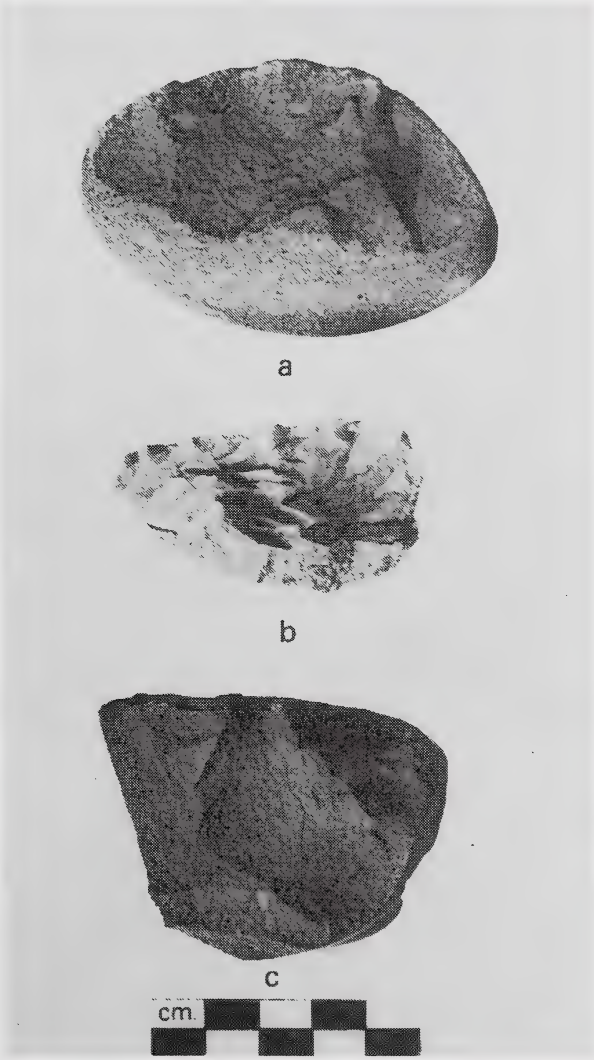

Figure 35: Simple single platform pebble or cobble cores.

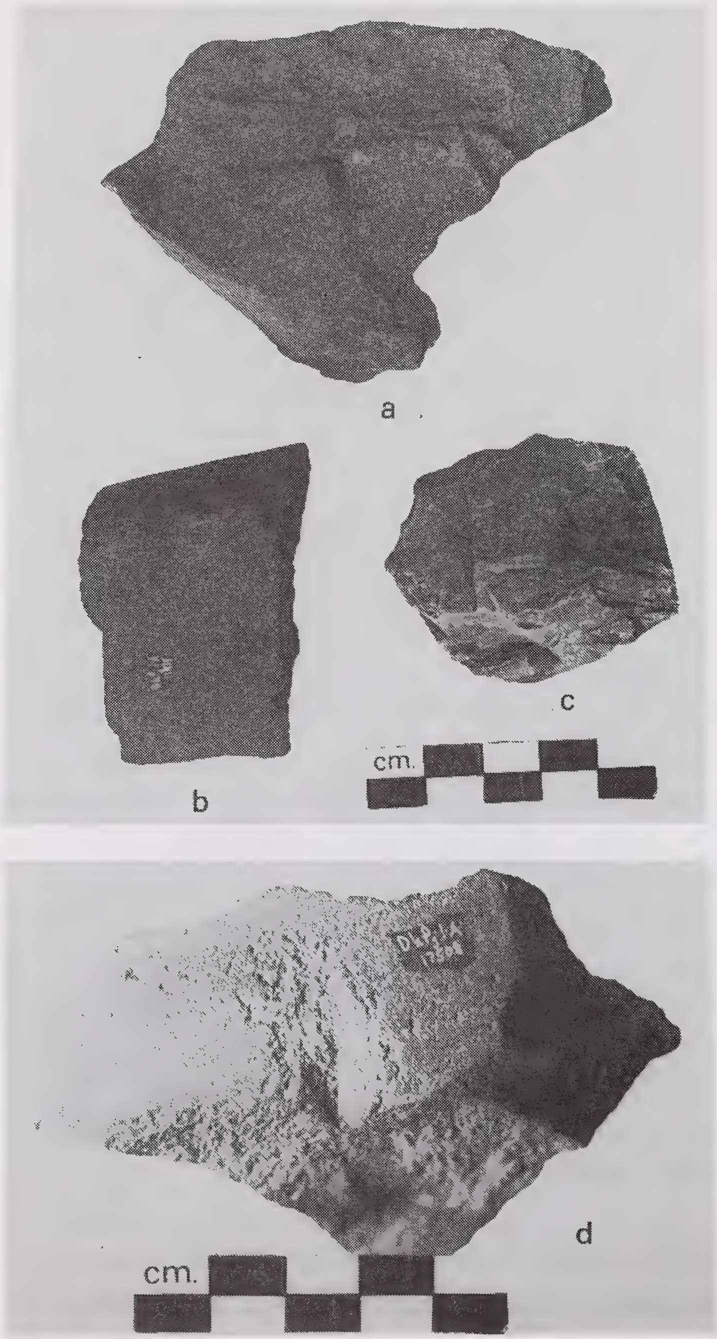

Figure 36: Miscellaneous lithic artifacts. Ventral face of simple cobble core: a; also used as anvil on dorsal face: d; Firebroken cobble chopper: b; amorphous multiple platform core: c.

Projectile Points

A total of 167 artifacts recovered in the 1983 excavations were classified as projectile points or fragments thereof. These artifacts were made from a wide variety of raw materials and were formed into several different styles, most of which are characteristic of the Late Prehistoric Period and are presumed to represent arrowheads. The degree of integrity represented by these specimens is quite diverse; only 27 of these are regarded as complete. The craftsmanship exhibited was also highly variable; some artifacts display the sophistication of design and cleverness of workmanship capable of a five year old, while others exhibit a considerable degree of skill and almost unbelievable control of intractable materials.

To initially classify the projectile points, the primary references used as a "key" were Forbis (1962, 1977) Kehoe (1966, 1973), and Reeves (1978, 1983a), although other sources were necessary to account for aberrant varieties. Considerable difficulty was encountered in classifying the small side and corner notched projectile points using these typologies as some disharmony was evident in the definitions of the particular varieties described. Varietal classification was also impeded by a lack of bilateral symmetry on most of these artifacts. As there seems to be a general concensus that a trend towards side notched forms with notches placed relatively high above the base occurs late in the Late Prehistoric, 11 artifacts were classified as "Plains Side-Notched" forms comparable to the Plains Side-Notched Type of Kehoe (1966, 1973), and the Nanton, Pekisko, Paskapoo, and Washita varieties of the Old Women's Phase described by Forbis (1962, 1977). More difficulty was encountered in the identification of the more narrow-based, broadly notched, often poorly made specimens representing the Prairie Side-Notched Type of Kehoe (1966, 1973) and the High River, Lewis, and Irvine variants of Forbis' Old Women's Phase (1962, 1977). The identification of this series of projectile point styles was complicated by the recognition of a small arrow point sized counterpart of the Besant atlatl dart point, referred to as the Samantha Side-Notched by Reeves (1983a) and the Small Samantha by Kehoe (1974). As this author was unable to see any objectively quantifiable means of discriminating the Prairie and Samantha types, this confusion was avoided by subsuming these into a category termed Small Notched projectile points. That a characteristic Besant arrowhead exists is evident at a number of sites, notably at the Muhlbach bison trap in central Alberta where a bimodal size distribution of projectile points was recovered from a single Besant component (Grunn 1969). How or why this Samantha type is distinguished from the early Old Women's Phase or the Prairie Side-Notched types is not clear. Gruhn (1969) notes a similarity of the smaller points in the Muhlbach assemblage with certain Nanton types described by Forbis (1962). Reeves (1983a:63) indicates that Samantha points are "not easily distinguished" from some of the Prairie Side-Notched points described by Kehoe (1966) including some Swift Current Fish-tail, Shaunavon Truncated Base, High River, Tompkins and Lewis points. He also suggests that two of Forbis' (1962) Irvine points and "certain Nanton forms", are in fact Samantha points (Reeves 1983a:63). Precisely how characteristic of Besant this type is, is further confused with the recognition that it occurs in Avonlea, Patten Creek and Parker Phases (Reeves 1983a). Some of the Samantha points recovered from the Leavitt site illustrated by Reeves (1983a: Figure 17) appear similar to the Head-Smashed-In Corner Notched variety illustrated in the same volume (Reeves 1983a: Figure 15). Kehoe (1974) suggests that some small Samantha types "strongly resemble Timber Ridge Sharp-eared variety Avonlea points from the Gull Lake Site" (Kehoe 1974:113). These relationships obviously need to be evaluated. As the terminal dates of Besant seem to be coeval with the beginning of the Old Women's Phase, this relationship should be investigated. Reeves has implied that the Old Women's phase replaces the Besant Phase as a serial phase in the Napikwan Tradition (1983a) but how or why this transition occurs, whether it represents culture change or continuity, is not clarified.

Problems with the confusion surrounding the Small Side-Notched projectile point typologies have been discussed elsewhere (Fredlund, 1981, Whelan 1976). The breakdown of the arbitrary varieties used by Forbis and Kehoe are recognized as useful in the context of their original useage but the utility of their universal application elsewhere as "diagnostic" is questionable.

What follows is the detailed metric and non-metric descriptions of the projectile points recovered during the 1983 field season at

Head-Smashed-In. Where possible we have employed typological names, such as Besant, Hanna, etc. to our assemblage. Otherwise, simple morphological descriptions such as stemmed, small notched, etc. have been used to group morphologically similar points. All metric and non-metric attributes, and the raw data, are presented in Appendix 3 according to the grouped point types discussed in the following pages.

1) Plains Side Notched (Figures 37, 38, 46) n=11

These are well made with side notches placed relatively high on the body forming proximal-lateral edges between the notch and base.

Raw Material:	Chert/chalcedony (8), silicified wood (2), silicified sediment (1)
Integrity:	Complete (2), tip missing only (4), tip and part of blade missing (1), part of base missing (2), lateral segment (1), tip and part of base missing (1).
Blank Type:	All of these are extensively bifacially flaked but two specimens retain flake scar surfaces from the flake blank and one has a cortex surface.
Flaking:	The flaking is well executed but no consistent flake scar morphology or pattern was observed.
Blade edges:	These are straight (8) or convex (7) and form even (7), sinuous (7), or slightly serrated (1) profiles.
Shoulders:	Most form angular junctures, usually perpendicular (8) or obtuse angled (4), otherwise they are slightly rounded and approximately perpendicular (2) or obtuse (1).
Notches:	These are quite variable but U-shaped (5) or expanding angular (5) notches are most prevalent, with parabolic (2), V-shaped (2) rectangular (2), and semicircular

notches (1) present. The notches are oriented either transversely (13) or slightly obliquely trending distally (4). They are formed bifacially (4) or alternately unifacially (3).

Proximal-Lateral Edges: These are well developed and are most frequently angular with the proximal-lateral edge oriented parallel to the longitudinal axis (10) or contracting distally (5), with one tabular example represented.

Base: The base edge is either straight (5) or concave (5). Basal thinning is poorly developed, and is usually marginal bifacial (5), bifacial with extensive thinning on one face and marginal trim on the other (4), and in one case the thinning is extensive on both faces.

Edge Grinding: Not present (8), otherwise it occurs on the base and stem edges (2), or just the lateral stem edges (1).

Use Wear and Tip Morphology: One specimen has a single rounded lateral edge (#16072, Figure 37 k), and one has nibbling retouch extending onto one face from the transverse distal tip truncation (#3533, Figure 37 g). The complete tips (4) are sharp, two are broken on flat truncations, one was snapped off, and one was broken by an impact fracture.

Heat Alteration: None apparent.

2) Small Notched (Figures 37, 38, 39, 45, 46) n=27

These are highly variable in morphology but do have the dimensions suggestive of use as arrowheads. Notches on these are relatively wide and are placed on the sides near the base. The notches are usually directed transversely but sometimes obliquely toward the distal end giving the impression of corner-notching.

Raw Material:	Chert/Chalcedony (15), silicified sediment (6), silicified wood (4), mudstone (1), and porcellanite (1).
Integrity:	These are complete (7), missing distal tips only (10), missing part of the base (4), missing part of the base and the tip (3), missing tips and most of blade (2) and one is a lateral segment.
Blank Type:	Three of these are marginally bifacially retouched flakes, seven are extensively bifacially retouched flakes bearing a remnant flake scar surface of the original flake, one of which has a cortex surface, and the remainder (17) are completely bifacially flaked. On two specimens the platform of the flake blank was present, in both cases occurring at the proximal end of the point.
Flaking:	No consistent flake scar morphologies were observed on any specimens, and for the most part no patterning was observed. On two specimens flaking was directed transversely from one blade edge and proximally trending obliquely from the opposite edge.
Blade edges:	These are straight (16), convex (16) or proximally skewed convex (3). In profile the blade edges are even and sharp (15), sinuous (13), or even and single bevelled (3).
Shoulders:	These are obtuse angular (16), perpendicular angular (12), perpendicular rounded (6), obtuse rounded (6), acute angled and blunt (3), or barbed (1).
Notches:	These tend to be broad and have parabolic (13), V-shaped (9), expanding angular (8), U-shaped (7), or crescentic (3) outlines, and are directed either

transversely (28), obliquely towards the tip (14), or obliquely towards the base (1). The notching was effected bifacially and bilaterally (12), alternately unifacially (5), bifacially and unifacially (3), or bilaterally unifacially (2).

Proximal Lateral Edges: These are poorly developed. Where a proximal-lateral edge is present it is parallel to the longitudinal axis (4), contracts proximally (3), is tabular (3), or expands proximally (1). Proximal-lateral junctures are otherwise eared (14), sharp (7), blunt (5), or irregular (6).

Base: These are straight (13), concave (5), convex (4), or irregular (1). Thinning is most frequently marginal and bifacial (9), or extensive and marginal (7), with unifacial marginal trim (2), single extensive and multiple extensive thinning (2), single extensive thinning and marginal trim (1), and extensive bifacial thinning (1) represented.

Edge Grinding: This was not present in thirteen cases, otherwise it occurred on the base and stem (4), on the base and notches (3), on the base only (2), on the notches only (2), on the base, stem and shoulders (1), or on the stem only (1).

Use Wear and Tip Morphology: Two specimens were observed to have a single blade edge rounded from use, and one specimen has bilateral edge rounding and transverse striations (Figure 40) suggestive of use as a reamer or drill. Where tips were intact they were sharp (6), blunt (1), or on the artifact described above, rounded. Breakage either occurred as impact fractures (5), snap fractures (5), or flat tranverse truncations (2).

Heat Treatment: One artifact had a discoloration attributed to heat and three were thermally damaged.

3) Avonlea (Figure 41) n=12

These are very well made projectile points, usually quite symmetrical, and have a triangular form with small side notches placed close to the base.

Raw Material: Chert/chalcedony (11), and porcellanite (1). Two of the former category are Swan River Chert and one fragment appears to be Knife River Flint.

Integrity: These are complete (3), missing distal tips only (3), missing part of the base and the tip (3), or are bases or basal fragments (3).

Blank Type: The brown chalcedony (K.R.F.?) specimen was formed by marginally retouching a flake, ten of these were completely bifacially flaked and one has extensive bifacial retouch but a remnant flake scar surface of the original blank is present. One very fine completely bifacially retouched specimen (#7958, Figure 41 e), was made by retouching a broken point tip to add alternate unifacial notches and a single bevelled concave base.

Flaking: The flaking on these artifacts is very well executed. Individual flake scars are often indistinct but where these are observable they tend to be transversely oriented and have a tendency to be shallow and parallel sided. On three specimens retouch is directed transversely from one blade edge and obliquely toward the proximal end from the opposite edge.

Blade Edges: These are either straight (7), or slightly convex (6) and form either sharp even edges (9) or are slightly sinuous in profile (4).

Shoulders: These are mostly obtuse angled (10), form a perpendicular angle (4), or in one instance rounded obtuse.

Notches: Small and positioned close to the base, most are V-shaped (8) or crescentic (4), and two angular notches and one parabolic notch occur. Notches were formed unifacially and bilaterally (3), alternate unifacially (2), bifacially and unifacially (2) or in one case bilaterally bifacial.

Proximal Lateral Edges: These are most frequently oriented parallel to the longitudinal axis and have angular proximal and distal junctures (7), in four instances they expand toward the base and in three cases they contract toward the base. On one of these projectile points, proximal lateral edges have not been developed and the stem edges form rounded ears.

Base: One base is straight, otherwise bases are slightly concave. Basal thinning is present on all of these and is bifacial except for the reworked example described above. On seven specimens the thinning occurred as several longitudinally oriented flake scars extending onto both sides of the blade.

Edge Grinding: This was observed on the base edges of four specimens and on two of these the notches were smoothened.

Use Wear and Tip Morphology: No use wear was observed on any of these artifacts. The points with complete tips were quite sharp and two specimen missing distal tips only were snapped. No distal fractures were interpreted as impact fractures.

Heat Alteration: The reworked specimen has a greasy lustre and partial red discoloration suggestive of thermal pretreatment. One other specimen is thermally damaged.

Comparisons: All of these conform to the Timber Ridge Side Notched variety as described by Reeves (1983a). The stubby porcellanite specimen (#16310) resembles several similarly stubby specimens recovered at the Morkin site (Byrne 1973: Plate 27:o).

4) Besant (Figure 38, 42) n=5

These represent the larger variety of the Besant Phase projectiles, presumably atlatl dart points. These are large, relatively thick, and have broad side notches.

Raw Material: All are chert or chalcedony, one of which is Swan River Chert. (None are K.R.F.).

Integrity: The smallest specimen is complete, one is missing the distal tip, two are broken between one notch and the opposing blade edge, and one is a base snapped just distal to the neck.

Blank Type: One is a marginally bifacially retouched flake, the others are completely bifacially retouched obscurring any details of the original blank.

Flaking: In all cases the flaking is non-patterned and of variable flake scar morphology, although the overall effect is relatively good.

Blade Edges: These are preserved on two dissimilar specimens. Both have convex blade edges, the smaller specimen has even edges, the larger specimen slightly sinuous edges.

Shoulders: Obtuse angular (3), obtuse rounded (1), square (1), or irregular (1).

Notches: These are parabolic (3), crescentic (2), or angular expanding (1). Both complete notches are present on only two specimens and on both the notches are assymetrically oriented; directed both transversely and obliquely (distally). Three specimens are notched bifacially bilaterally and one is bilaterally unifacial.

Proximal-Lateral Junctures: These are either eared (5) or blunt (2).

Base: Base edges are concave (3), gullwing shaped (1), or straight (1). Thinning was observed on four specimens; marginal unifacial trim (1), marginal bifacial trim (1), marginal and extensive thinning (1), and marginal trim with a single extensive thinning flake (1).

Edge Grinding: This was present on the notches and base (2), on the base and stem edges, or on the lateral stem edges only. The one specimen on which edge grindng was not apparent was sufficiently thick and blunt that grinding would be of little utility.

Use Wear and Tip Morphology: The specimen described above has had both lateral edges worn smooth, almost flat, and has a minute portion of the tip snapped off. Wear was not observed on the other specimens although one almost complete specimen, found suspiciously close to a large glacial erratic, has a broad deep impact scar extending longitudinally from the tip.

Heat Alteration: Two of these artifacts were crazed, discolored and potlidded due to thermal damage.

Comparisons: Specimen #7858 resembles a Besant atlatl point illustrated in Reeves (1983:Figure 13:9) from Head-Smashed-In and a "Large Samantha" type illustrated in Kehoe (1974 Figure 2:W) from the Walter Felt site in south-central Saskatchewan.

5) Triangular (Figures 43, 44) n=30

Thirty triangular unnotched, or rather notchless, flaked stone artifacts were recovered which share characteristics of dimensions, workmanship, and symmetry comparable to projectile points.

Raw Material: Most of these are chert or chalcedony (22), with silicified sediments (5), obsidian (1), petrified wood (1), and porcellanite (1) also represented.

Integrity: Complete (9), distal tip missing (9), part of base and tip missing (5), part of base missing (4), or bases only (3).

Blank Type: One of these is a uniface made on a flake, two are marginally bifacially retouched falkes, and the remainder are bifaces, nine of which retain a surface from the original flake blank including one cortex surface. In two instances part of the platform of the flake blank is present, one is situated at the point base and the other is near the tip on one lateral blade edge.

Flaking: Workmanship on these specimens is quite variable but in no instance was a particular flake scar type or pattern discerned.

Blade Edges: These are mostly straight (23) or convex (14), and distally skewed convex (2), proximally skewed convex (1), angular (1), and concave (1) blade edges observed. In profile blade edges are straight and even (20), sinuous (13), single bevelled (7), or serrated (1).

Base: Base edges are most often straight (18), or either slightly concave (5) or convex (4). Basal thinning was observed on twenty seven specimens and was usually accomplished by marginally retouching one face and extensively retouching the other (12), with marginal bifacial trimming (5), extensive bifacial thinning (5), marginal unifacial retouch (4), and extensive unifacial thinning (1) also present.

Edge Grinding: No edge grinding was observed on any of these specimens.

Use Wear and Tip Morphology: Use wear was observed on only one artifact, an obsidian specimen, and occurs as rounding of one lateral blade edge and the tip. Tips, where present, are sharp (7), blunt (3) or worn (1), otherwise they were truncated on flat transverse breaks (6) or snapped off (1). No impact fractures were observed.

Heat Alteration: Two specimens had discolorations attributed to heating and four specimens were thermally damaged.

Remarks: The absence of edge grinding and impact fractures, and the virtual absence of use wear on these specimens, suggests that these many have been projectile point preforms rather than finished products in accordance with the results of Fredlund (1981). Her hypothesis of an "Expanding Flake Point Tradition" could not be substantiated with this sample however.

6) Northern Side Notched (Figure 42 a) n=1

An unusual large base of a concave based point with small side notches placed high on the body. This specimen was found on the surface.

Raw Materials: Gray porcellanite

Integrity: A base snapped transversely between the notches.

Blank Type: Indeterminate, this artifact fragment is completely bifacially flaked.

Flaking: Non-patterned but well executed.

Blade Edges: Missing.

Shoulders: Missing.

Notches: Distally truncated, relatively shallow, although incomplete these appear to have been rounded expanding notches formed bifacially.

Proximal-Lateral Edges: These are long, straight, well formed, and contract from the notch junctures to form approximately perpendicular junctures with the base.

Base: The base is uniformly concave and has been thinned by a single long broad flake scar on one face and several relatively long parallel sided flake scars on the opposite face.

Edge Grinding: Both the base and stem edges, including the notches, have been ground smooth.

Use Wear and Tip Morphology: No wear was observable.

Heat Alteration: None apparent.

Comparisons: This aberrant point type has been classified as a Northern Side-Notched point as defined by Gruhn (1961:130). Although this specimen varies from those illustrated from Wilson Butte Cave (Gruhn 1961 Plate 14:I,J and Plate 16 D,E), particularly in the depth of notching, this specimen does fit the theme of a large side-notched point tradition with a northern distribution. Identical specimens to this artifact recovered at Head-Smashed-In have not been observed, however some very similar projectile points from Sudden Shelter in the Great Basin are represented by the Northern-San Rafael-Sudden Side Notched series with a temporal distribution of 4,600 to 7,000 years B.P. (Jennings et al. 1980).

7) Broad V-Shaped Side Notched (Figure 38 1) n=1

A relatively short, broad, and thick artifact with very broad shallow side notches and a short blade.

Raw Material: Brown chalcedony with a white patina, possibly K.R.F.

Integrity: Complete

Blank Type: This artifact is extensively bifacially flaked but a remnant bulbar surface of the original flake blank occurs on one face.

Flaking: Flake scars are of variable morphology but form a "chevron" pattern on one face. Workmanship can be described as poor however.

Blade Edges: These are straight, sinuous, relatively sharp, and contract to form an abbreviated blade with an obtuse angled tip.

Shoulders: Both shoulders are angular, one is perpendicular and the other obtuse angled.

Notches: Very broad and shallow parabolic notches, oriented transversely. One is bifacially formed and the other is unifacial.

Proximal-Lateral Junctures: These are both perpendicular angled.

Base: The convex base is a thin interfacial surface with marginal unifacial trim extending distally from one edge of the base.

Edge Grinding: Present on base and stem eges.

Use Wear and Tip Morphology: The tip is complete and no use wear is evident.

Heat Alteration: None evident

8) Flake Point (Figure 39 1) n=1

A single specimen represents an expanding flake which has been minimally modified to form notches and a tip.

Raw Material: Argillite

Integrity: Complete

Blank Type: An expanding flake with an irregular hinge termination which is present as the base of this artifact.

Flaking: Marginal and irregular

Blade Edges: One blade edge is straight, one is proximally skewed convex, both form sinuous profiles.

Shoulders: One is diminutive and angular, the other is rounded.

Notches: Shallow parabolic and crescentic formed alternate unifacially (right).

Proximal-Lateral Junctures: One is round and the other is irregularly angular, neither has been retouched.

Base: An irregular recurving form, the base has not been retouched or thinned.

Edge Grinding: Not present.

Use Wear and Tip Morphology: The tip is surprisingly sharp and no use wear is apparent.

Heat Alteration: None apparent.

9) Side and Blade Notched (Figure 38 n) n=1

A single curious specimen with broad side notches forming a relatively long and narrow stem, the blade edges have been notched near the truncated tip.

Raw Material: Swan River Chert

Integrity: Distal tip missing.

Blank Type: Indeterminate, bifacial flaking extends across both faces.

Flaking: Irregular, non-patterned and poorly executed.

Blade Edges: These appear to have been straight to slightly convex with straight profiles, however the blade edges are partly missing with the addition of a V-shaped and a crescentic notch on either blade edge.

Shoulders: Both are angular, one is perpendicular and one is obtuse.

Notches: These are very broad, bifacially formed, and have a semicircular outline. They are directed transversely but have removed most of the corners.

Proximal-Lateral Junctures: Both are rounded almost perpendicular junctures.

Base: Narrow with a V-shaped concavity. Thinning is poorly developed and occurs as marginal bifacial trim.

Edge Grinding: Not present.

Use Wear and Tip Morphology: No wear is evident, the tip is broken off on a flat transverse fracture.

Heat Alteration: None apparent.

10) Small Stemmed (Figures 38 c, 39 c) n=2

These are very small arrowheads with approximately rectangular stems and ovate serrated blades. These two artifacts are quite similar in all dimensions and overall morphology.

Raw Material: Obsidian (1) and brown chalcedony (1).

Integrity: Both are complete

Blank Type: The chalcedony specimen was made by marginally retouching a flake, the obsidian artifact was extensively bifacially flaked but a remnant cortical surface occurs on one face.

Flaking: Flake scar morphologies are variable and non-patterned.

Blade Edges: Both have assymetrically convex blade edges. The chalcedony specimen has no retouch on one naturally sharp edge but the other edge was carefully and minutely serrated. The obsidian artifact has sharp slightly sinuous and serrated edges.

Shoulders: These are minimally developed and form obtuse junctures with the stem edges.

Proximal-Lateral Junctures: These are obtuse angled and on both specimens one juncture is rounded and one is angular. Lateral stem edges are parallel.

Base: Both are slightly convex. Thinning was observed on the obsidian specimen only, and occurred as multiple marginal and extensive scars.

Edge Grinding: Not present.

Use Wear and Tip Morphology: Both have sharp tips and no use wear is apparent.

Heat Treatment: Not apparent.

Remarks: No similar specimens have been reported previously from Head-Smashed-In. The obsidian specimen (#6846) was found in situ in a pit feature. A date of 1300±70 B.P. on charcoal (AECV #22C) suggests a Late Prehistoric age for this specimen.

11) Lanceolate Concave-Based (Figures 38 m, 42 b) n=2

These are quite dissimilar but share the characteristics of a concave base edge and both lack notches. The larger specimen is probably a dart or spear point.

Raw Material: Swan River Chert (1), and silicified siltstone (1)

Integrity: Both are missing tips, one is broken obliquely through the blade, the other is broken transversely.

Blank Type: Bifacial flaking has completely removed the orignal blank surfaces.

Flaking: Irregular and non-patterned on the small point, as most of the larger specimen is missing the flaking is largely indeterminate but the basal thinning as described below was well executed.

Blade Edges: Only one blade edge is present, on the smaller artifact, and occurs as a distally skewed convex form with a sinuous profile.

Proximal-Lateral Junctures: The blade edges form acute angled distally trending tangs with the base on the smaller artifact, on the larger specimen the junctures are approximately perpendicular and slightly rounded.

Base: Both are concave, the larger specimen is only slightly concave. Thinning on the latter occurs as a single large broad thinning flake scar on one face and several long relatively deep parallel sided flake scars on the opposite face. The other specimen is unifacially thinned with several extensive scars.

Edge Grinding: Not present.

Use Wear and Morphology: No use wear is evident, the irregular fracture which broke the blade on the small point may be an impact fracture.

Heat Alteration: The larger fragment was broken on an irregular fracture which appears to have been thermally induced. This artifact was recovered from a hearth.

Remarks: The larger base fragment (#1535) resembles some Early Prehistoric types, such as Plainview or Meserve, although this specimen is somewhat smaller. An enigmatic modern determination on bone collagen (Beta 7791) recovered from the hearth in which this specimen was apparently thermally fractured suggests a fortuitous association in this hearth.

12) Hanna (Figures 38, 42) n=3

These are represented by three proximal fragments which have broad notches directed from the corners.

Raw Material: All three are chert. One of these (#7759) is Swan River chert and one with a chalky white exterior (#7829) may be Avon Chert.

Integrity: These are all broken between one notch and the opposite blade edge at, or just distal to, the shoulder. Two of these as well have a proximal corner snapped off.

Blank Type: One of these (#7829) was made by marginally bifacially retouching a thin flake, the other two specimens have been completely bifacially flaked.

Flaking: Indeterminate

Blade Edges: Indeterminate

Shoulders: The two shoulder remnants are partly broken but appear to have been rounded obtuse.

Notches: The one complete notch is a rounded V-shape oriented obliquely toward the distal end. On two specimens the notching technique is alternate unifacial (right).

Proximal-Lateral Junctures: There are rounded ears on two specimens and a blunt rounded acute angled juncture on the other specimen.

Base: Slightly concave (2), or slightly convex (1). Thinning on the latter specimen was extensive bifacial, on the other two specimens it occurred as either marginal bifacial trimming or marginal and extensive thinning.

Edge Grinding: Present on both the stem edges and base (2) or stem edges only (1).

Use Wear and Tip Morphology: No use wear could be observed on these fragments but it is notable that the similarities of fracture morphology and orientation represented by these specimens may indicate a similar mode of breakage.

Heat Alteration: Not apparent.

13) Corner Notched (Figures 38 g, 39 e) n=2

Two artifacts exhibit deep corner notching and slightly barbed shoulders. Both of these were recovered from the surface.

Raw Material: Quartzite (1) and Obsidian (1).

Integrity: Both are missing tips, the quartzite specimen is missing most of the base and the obsidian point is missing one shoulder and the opposite basal corner.

Blank Type: The quartzite artifact is completely bifacially flaked, the obsidian artifact is extensively bifacially flaked but retains bulbar surfaces of the original flake blank.

Flaking: Irregular and non-patterned on the obsidian specimen, flaking is indistinct on the quartzite specimen but is well executed despite the nature of the raw material.

Blade Edges: Both have straight blade edges, one edge on the obsidian specimen is partly broken, otherwise edges are even in profile.

Shoulders: The shoulder on the obsidian specimen is acute angled and sharp (barbed), the quartzite specimen has one barbed and one perpendicular angled shoulder.

Notches: Notch shapes are quite rounded but these are incomplete. They are directed obliquely toward the distal end and are unifacially formed; unifacially bilaterally on the obsidian specimen; alternately unifacially (left) on the quartzite specimen.

Proximal-Lateral Junctures: The one corner represented is obtuse angled and blunt.

Base: The one base is narrow and convex, and thinning occurs as marginal bifacial trim.

Edge Grinding: None apparent.

Use Wear and Tip Morphology: No use wear is apparent. The quartzite specimen has a snapped off tip, the tip on the obsidian specimen is truncated on a flat transverse fracture.

Heat Alteration: None apparent.

14) Notchless Eared (Figure 39 d,e) n=2

These are relatively small points with laterally trending basal ears or tabs and have no notches.

Raw Material: Quartzite (2).

Integrity: One is complete, one is missing the tip and one basal corner.

Blank Type: Both specimens are completely bifacially flaked, blank attributes are obscured.

Flaking: The flaking on the complete specimen is non-patterned but well executed, on the other specimen flaking is irregular and non-patterned.

Blade Edges: On the complete point these are convex and even, on the other specimen they are straight and sinuous.

Shoulders: Absent

Notches: Absent

Proximal-Lateral Edges: The point fragment has a tabular ear with a proximally contracting proximal-lateral edge, the other specimen has a laterally projecting rounded ear and a rectangular tab with a proximal lateral edge oriented parallel to the longitudinal axis.

Base: Slightly concave on the fragment and straight on the complete specimen. Thinning on the latter occurs as multiple extensive scars on both faces.

Edge Grinding: On both of these grinding is present on the tabs but not on the base.

Use Wear and Tip Morphology: The complete artifact has a sharp tip and no wear was observed on either specimen.

Heat Alteration: None apparent.

15) Non-Classified Projectile Point Fragments (Figures 37, 38, 42, 44, 45, 46) n=67

These fragments have attributes or dimensions regarded as representative of projectile points. These include bases (23), tips (17), midsections (8), lateral segments (6), blades (5), points missing either tips and part of the base (4) or just missing tips (2), and fragments which could not be oriented, either blade or basal fragments (2). Of these fragments, three bases (Figures 42 j,k and 45 z), three midsections (Figures 42 i,l and 45 o), and at least one tip (Figure 45 g), are of the overall size and morphology indicative of atlatl dart tips, the other fragments appear to be pieces of arrowheads. Four fragments are blades which have a single shoulder and notch remnant indicating they were either broken during manufacture or represent a single notched artifact type (Figures 45 a and 46 a,b,c). Raw materials represented in this category include cherts or chalcedonies (46), fine grained silicified sediments (12), porcellanite (3), obsidian (2), nonsilicified sediments (2), quartzite (1), and petrified wood (1).

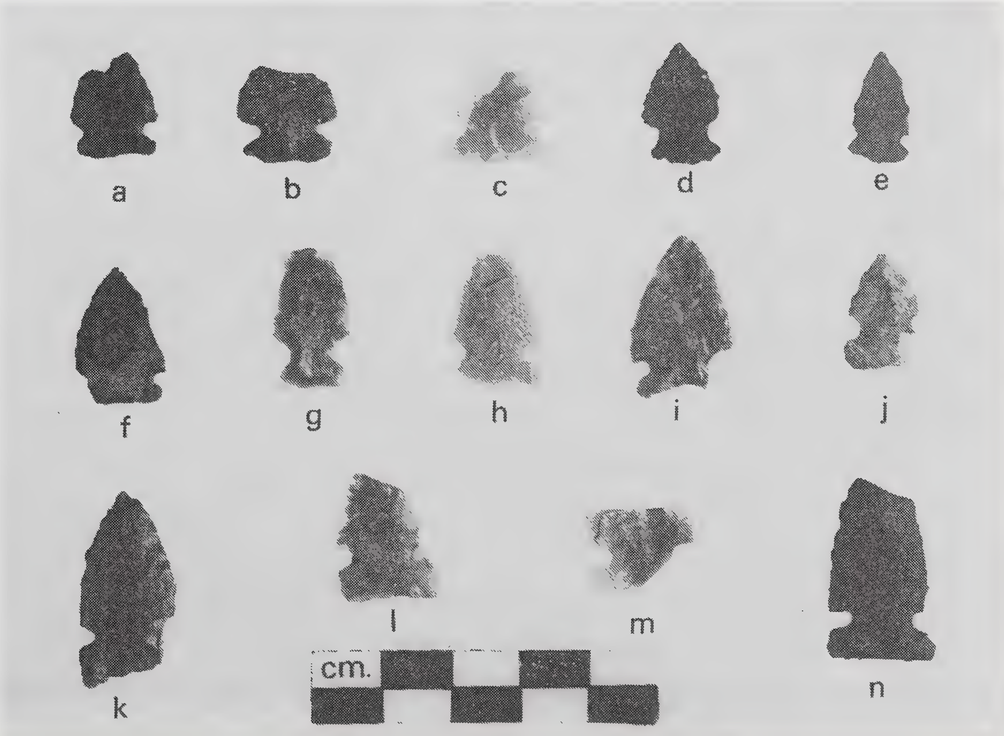

Figure 37: Projectile points. Small notched: a, b, d-f, i; Plains side notched: c, g, h, j-l, n; non-classified: m.

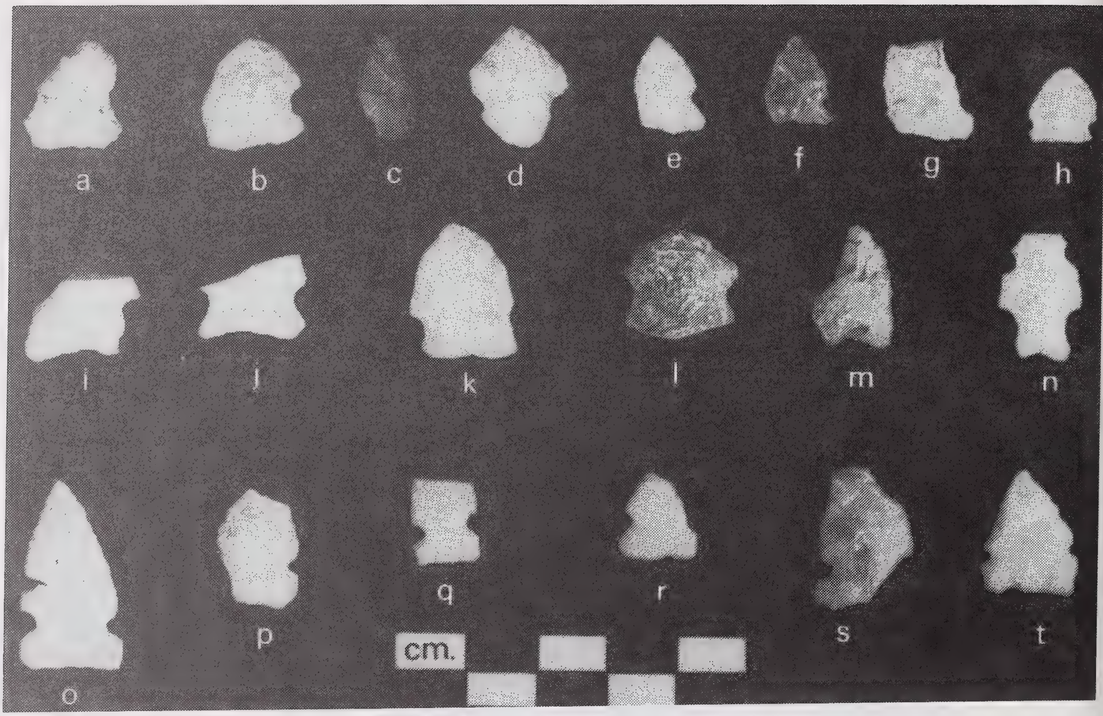

Figure 38: Projectile points. Small notched: a, b, e, f, h, r, s; Small stemmed: c; Non-classified: d, p; Notchless eared: g; Hanna: i, j; Besant: k; Broad V-shaped side notched: l; Lanceolate concave-based: m; Side and blade notched: n; Plains side notched: o, q, t.

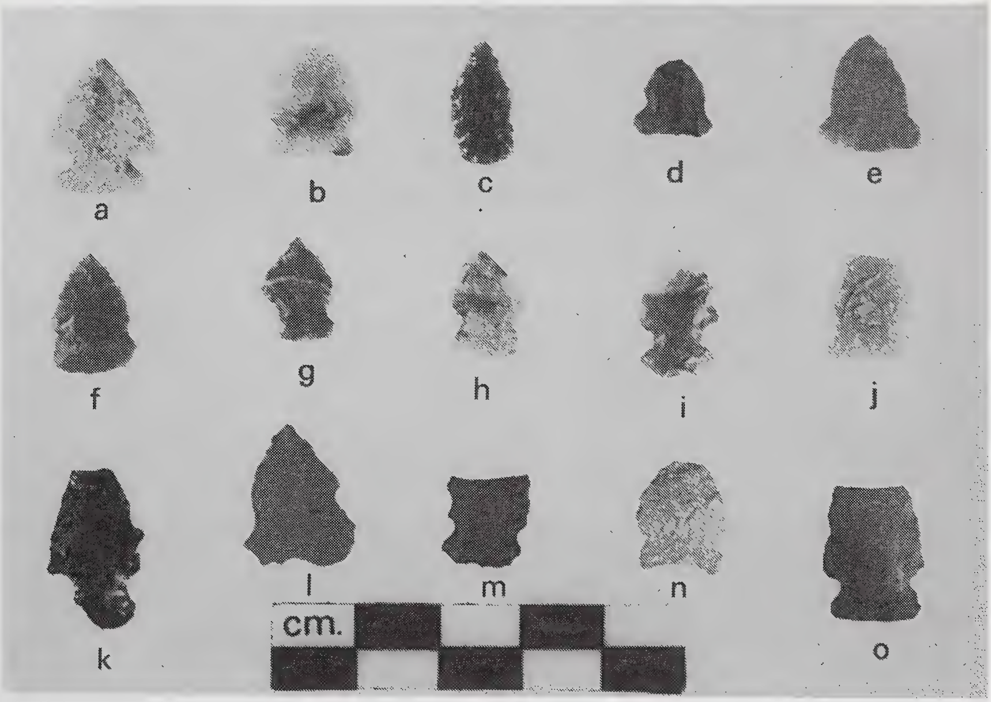

Figure 39: Projectile points. Small notched: a, b, d, f-j, m-o; Small stemmed: c; Notchless eared: e; Corner notched: k; Flake point: l.

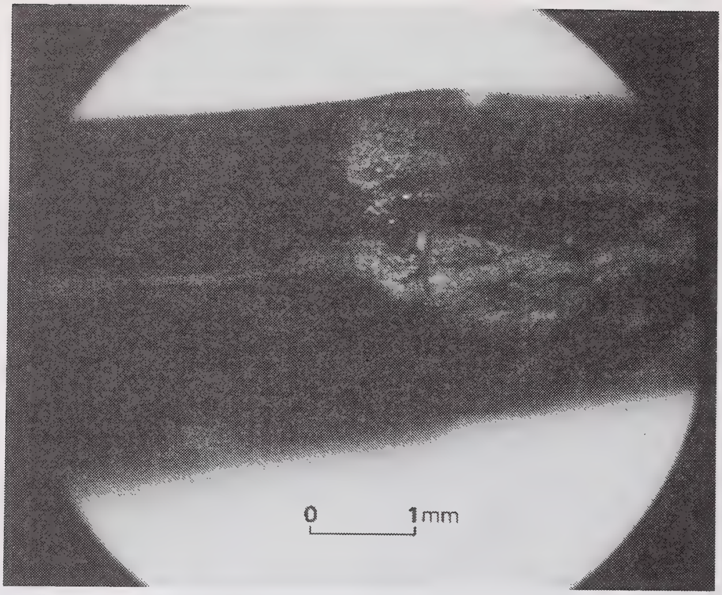

Figure 40: Detail of transverse striations and rounding of blade edge on a small notched projectile point (#7812).

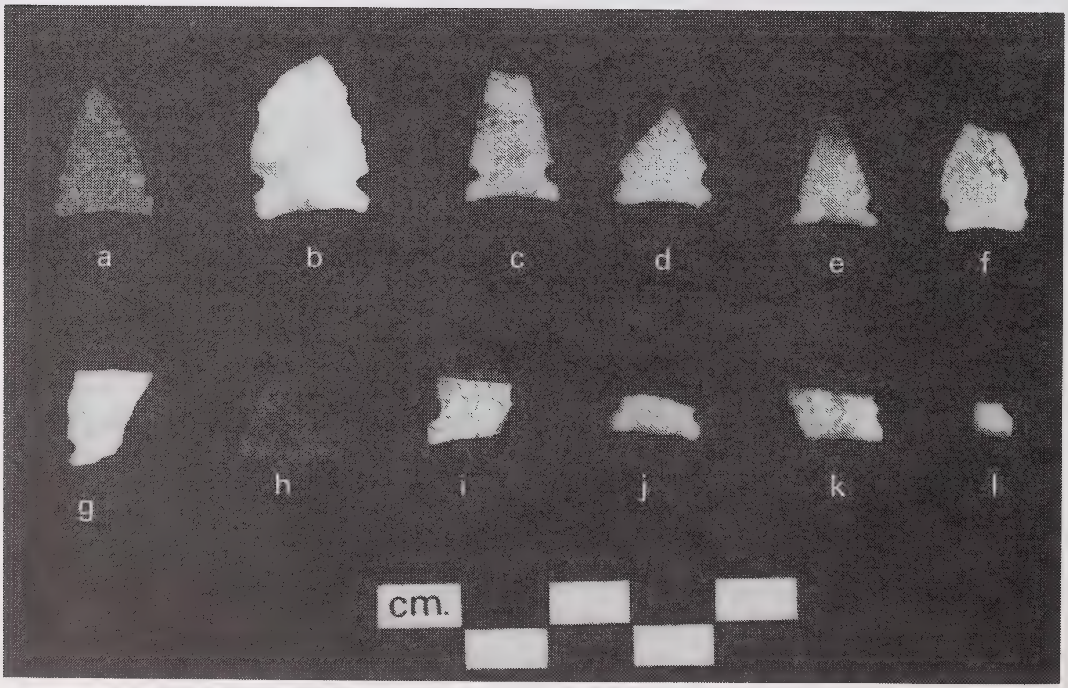

Figure 41: Avonlea projectile points.

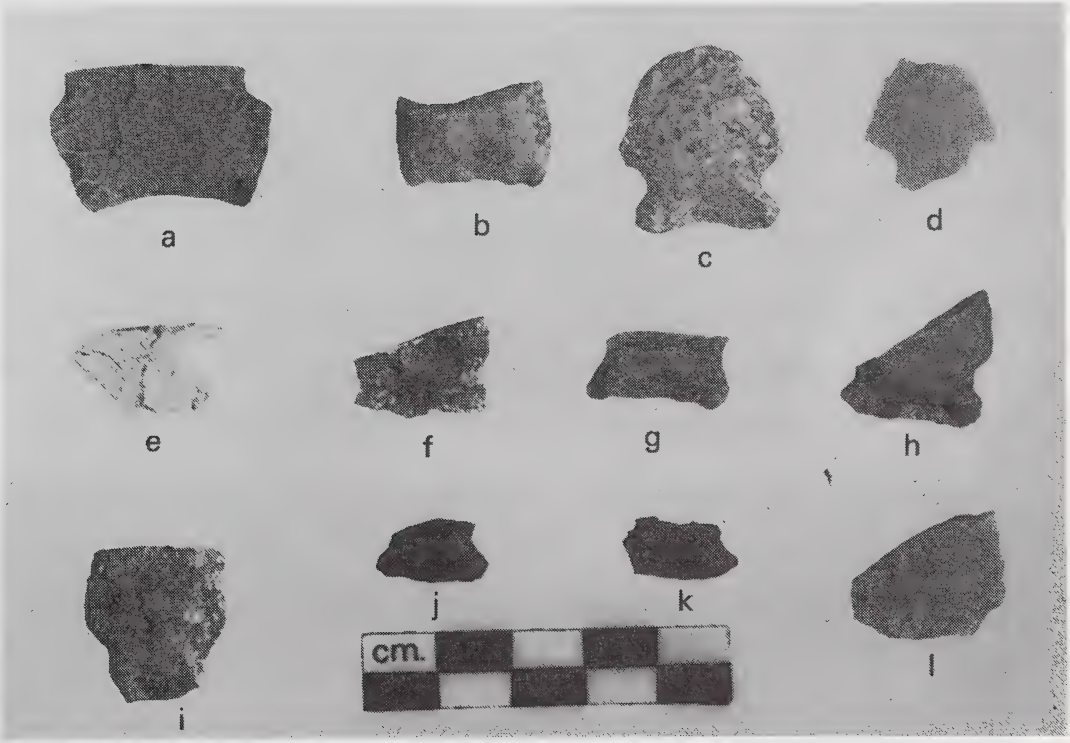

Figure 42: Projectile point fragments. Northern side notched: a; Lancolate concave-based: b; Besant: c, f-h; Corner notched: d; Hanna: e; Non-classified: i-l.

Figure 43: Triangular projectile points or preforms.

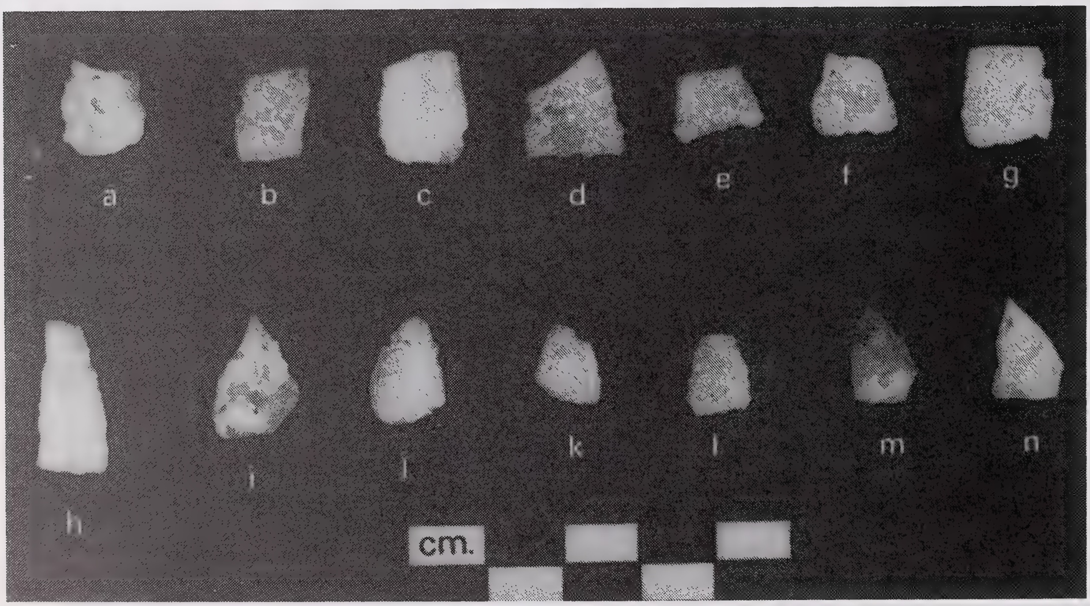

Figure 44: Triangular projectile points or preforms.

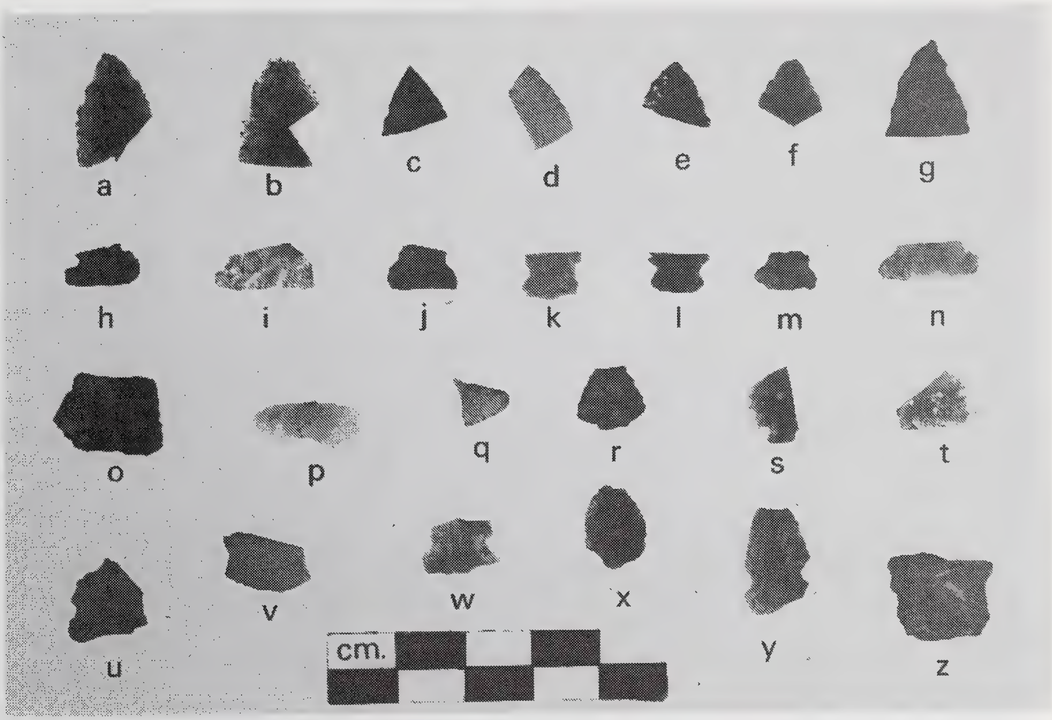

Figure 45: Projectile point fragments. Non-classified: a-t, v, w, x, z; Small notched: u, y.

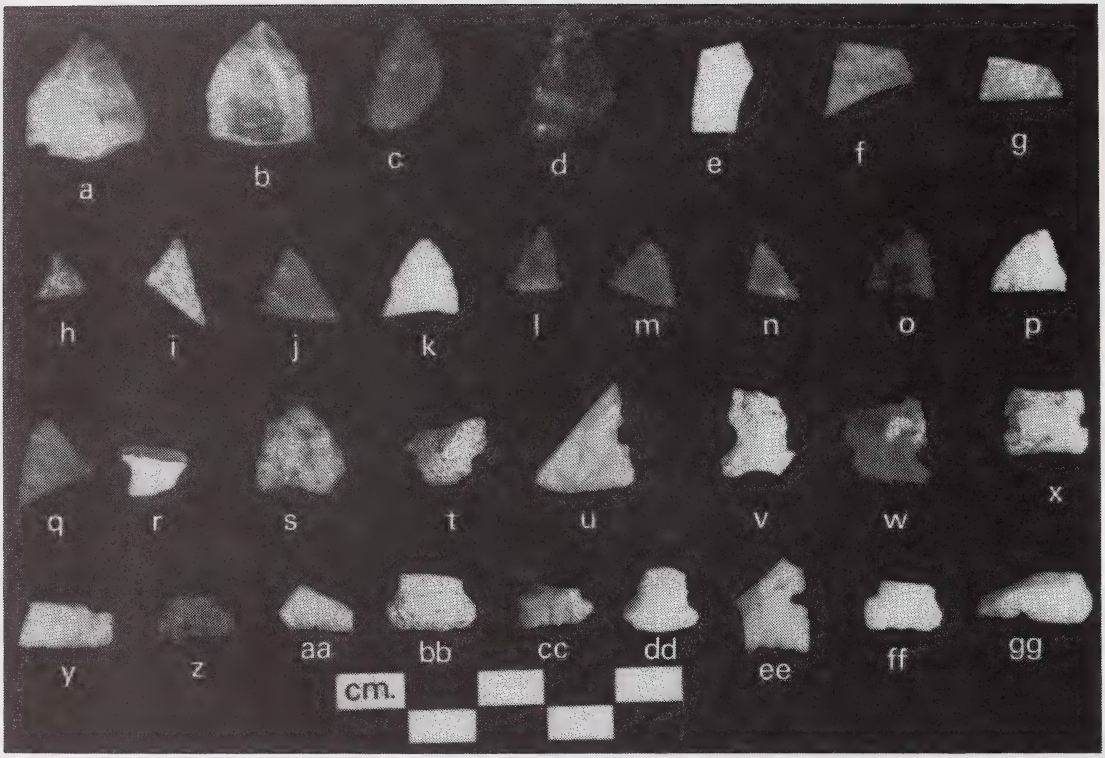

Figure 46: Projectile point fragments. Non-classified: a-v, x-dd, ff, gg; Plains side notched: ee; Small notched: w.

Other Flaked Stone Tools

1) Hafted Biface (Figure 47 d)

A large side notched specimen made by marginally bifacially retouching a relatively thick quartzite flake. This artifact was snapped transversely through the blade after it had been used, and the right shoulder and right proximal-lateral juncture have been truncated. The base is convex and is marginally trimmed onto one face. The parabolic, proximally trending notches were formed by alternate unifacial retouch which appears on the left side of either face. These notches are separated from the base by vertical proximal-lateral edges. No basal grinding is apparent but the edge of the remaining obtuse angled shoulder is ground or worn. Both of the sinuous blade edge remnants have been rounded from useage.

Length: 30.0 mm
Maximum Width (at shoulders): 27.0 mm
Maximum Thickness: 8.3 mm
Stem/Base Width: 22.2 mm
Neck Width: 18.8 mm
Weight: 8.5 gm

2) Hafted Spokeshave/Gravers (Figure 48) n=4

These artifacts have outlines similar to projectile points but are morphologically and functionally dissimilar. They were made by marginally unifacially retouching flakes, or flake fragments onto their dorsal faces to produce shallow notches and steeply angled edges converging to a pointed tip. All have plano-convex to plano-triangular transverse cross sections, and have ventral surfaces which are concave in longitudinal section. On all of these a ridge longitudinally bisects the dorsal face, and in only one instance is the ventral face modified.

This latter artifact (#14830, Figure 48 a), the largest of the four, has broad shallow notches formed by alternate unifacial retouch extending onto the right side of either face. These notch edges have been ground or worn smooth. One blade edge is concave; the other is convex and recurves distally to form a blunt protruding tip. The convex blade edge is marginally bifacially retouched, but this forms a single bevelled edge. The concave blade edge segments adjacent to the tip are nibbled and rounded onto the dorsal side of the edges, and the tip itself is smoothened from use. The convex base is the distal hinge termination of the original flake blank.

The other three specimens have triangular outlines, shallow unifacial side notches, and slightly broken but sharp tips. Two of these tools (#7860 and #14831, Figure 48 d,b) have minute nibbling scars extending onto the dorsal side of either blade edge. The bases on these artifacts are unmodified. The other artifact (#18975, Figure 48 c) has irregular, apparently unused, assymetrical blade edges and an irregularly formed base.

A minute flake scar extends onto the ventral face from the distal tip on two of the smaller specimens (#14831 and #18975). These small fractures indicate pressure or an impact was directed against the distal tips. Although the slight distal fracturing on these two artifacts may be interpreted as impact fractures, these do not seem to be suitable as projectile points, and the wear exhibited on the blade edges seems more consistent with a spokeshave function. Three of these (#14830, 14831, 18975) were found within 2 metres of each other.

Cat. No.	7860	14830	14831	18975
Weight	0.3 grams	1.7 grams	0.5 grams	0.2 grams
Length	13.2 mm	22.1 mm	15.2 mm	12.8 mm
Width	10.0 mm	16.1 mm	10.1 mm	5.9 mm
Thickness	2.4 mm	5.2 mm	3.6 mm	2.1 mm
Neck Width	8.3 mm	11.9 mm	7.7 mm	4.5 mm
Edge Angle 1	80^0	65^0	75^0	55^0
Edge Angle 2	75^0	70^0	70^0	65^0
Raw Material	Chert	Chert	Chalcedony	Silicified Sandstone

3) Flake Knife (Figure 47 a)

An asymmetrically expanding flake of Knife River Flint, the platform of which has been blown off. This artifact has been marginally unifacially retouched on one lateral flake margin and the distal edge to form an approximately ovate point. The shorter lateral flake edge forms the base which has been marginally unifacially retouched and blunted or crushed by means of small step terminated fractures which have been directed into the edge. One lateral extreme of this crude base has been unifacially retouched to form a slight corner notch and approximately square shoulder, the opposite stem edge (the platform remnant) is unmodified, contracting distally from an obtuse juncture with the blade. All retouch on this specimen is marginally unifacially flaked onto the dorsal face except for a short length of bifacial retouch on one edge at the tip. The cross section is concavo-triangular. No use wear is evident although a minute portion of the distal tip appears to have been nicked off.

Length: 27.8 mm
Width: 15.0 mm
Thickness: 3.8 mm
Stem Length: 6.3 mm
Weight: 1.4 grams

4) Flake Butt Drills (Figure 47 b,c) n=2

Both of these have narrow elongate bits with diamond shaped cross sections, and were fashioned from flakes using marginal bifacial retouch. The one complete specimen (#16493, Figure 47 c), made of a pale blue chalcedony has a relatively short tapering and obliquely terminated bit, protruding in a skewed orientation out of a semicircular butt end. The other specimen (#3480, Figure 47 b), made from a mottled brown chert, is quite symmetrical; the bit is relatively long and is almost parallel sided for most of its length. The butt end has been transversely snapped just proximal to the bit, lending a T-shaped planform to this artifact. This snap fracture clearly truncated a proximal portion which would have given the complete tool a different planform morphology. Neither artifact has any obvious use wear, but the broken drill has a slight polish on all high points, including the fracture margins, probably a result of weathering.

Cat. No.	3480	16493
Weight	1.0 grams	0.7 grams
Length	25.6 mm	19.8 mm
Width	18.3 mm	15.9 mm
Thickness	4.4 mm	3.7 mm
Bit Length	20.8 mm	11.2 mm
Bit Width (at midpoint)	4.1 mm	3.4 mm

5) "Awls" (Figures 47 e,f) n=2

Both specimens are thick and elongate, and completely bifacially flaked to form steep angled sinuous edges. They are transversely truncated to about the same length and have a small flat transverse facet at the intact end. Both are made from chert, one of which is a fine white Swan River chert. This latter artifact (#3612) has approximately parallel lateral margins and a diamond shaped cross section, the other (#2115) has slightly divering margins and a thickly biconvex cross section. No use wear is evident.

Cat. No.	Weight	Length	Width	Thickness	Average Edge ANGLE
2115	2.6 grams	25.8 mm	14.0 mm	7.7 mm	70^{o}
3612	2.6 grams	27.0 mm	11.2 mm	7.1 mm	80^{o}

6) Pièces Esquillées (Figure 48) n=3

All three specimens have almost rectangular forms, except they have one narrow end. One of these (#17809, Figure 48 m) is quite well made and symmetrical, with bifacial flaking forming angular junctures and almost obscuring the flake scar surfaces of the original flake blank. The narrow end has not been retouched, and is scalloped out on one face by a blow delivered from near the end of one lateral margin. The lateral margins have been crushed. The largest specimen (#17290, Figure 48 l) was made on a pebble spall. One lateral margin is a flat interfacial fracture surface which lends a triangular cross section to this artifact. The other lateral edge and the wide end have been bifacially flaked, and both ends and the lateral edge have been crushed on the margins. The third pièce esquillée (#18617) is an unmodified flake derived from a core by the bipolar technique. One lateral edge and both ends have been crushed along their margins.

Cat. No.	17290	17809	18617
Weight	9.0 grams	2.5 grams	1.7 grams
Length	35.4 mm	20.7 mm	20.7 mm
Width	24.0 mm	19.0 mm	16.2 mm
Thickness	11.6 mm	5.6 mm	4.3 mm
Raw material	Silicified Siltstone	Siliceous Mudstone	Silicified Siltstone

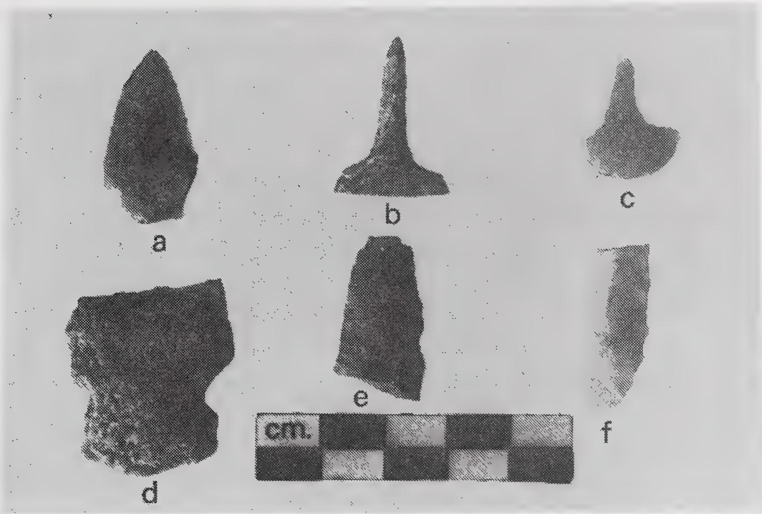

Figure 47: Miscellaneous flaked stone tools. Flake knife: a; drills: b, c; hafted biface: d; "awls": e, f.

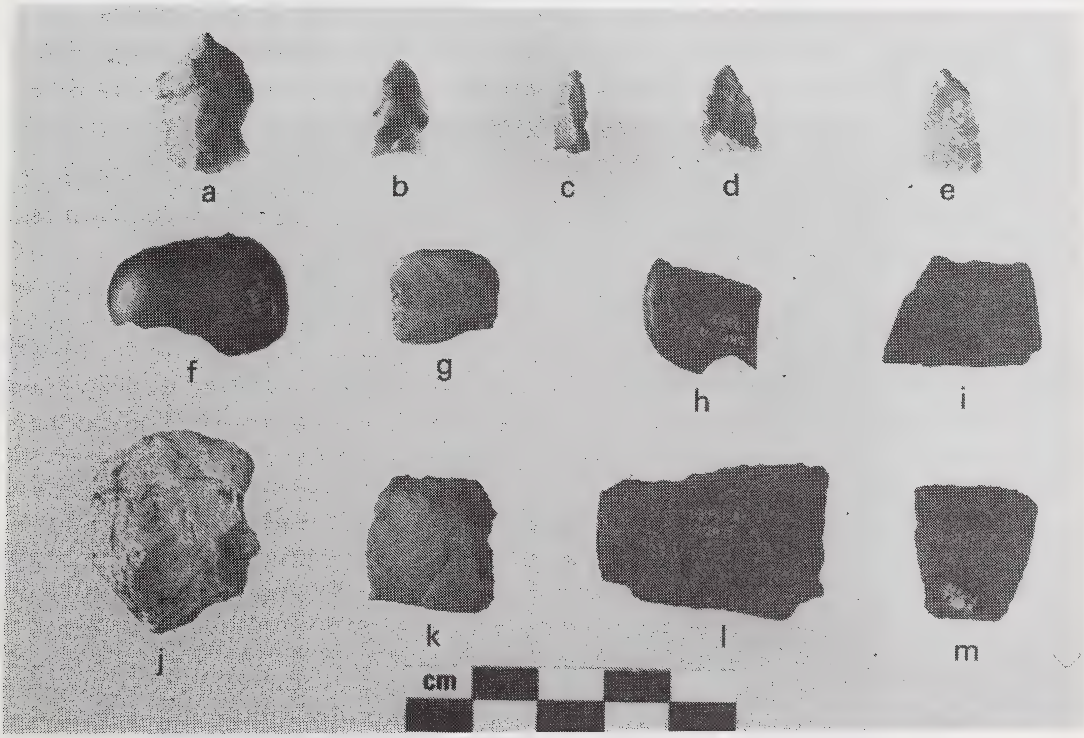

Figure 48: Miscellaneous flaked stone tools. Hafted spokeshave/gravers: a-d; reamer: e; single utilized edge flake: f; single unifacially retouched edge flakes: g, h; single bifacially retouched edge flakes: i, j; multiple retouched edge flake: k; pièces esquillées: l, m.

7) Endscrapers (Figure 49) n=28

Fifteen endscrapers were fashioned by marginally retouching a flake or spall, eleven have been completely unifacially flaked, and two have been partly bifacially flaked on the lateral margins. Of the twenty three endscrapers which retain characteristics of the original blanks, approximately half were made on bipolar split pebble spalls or cores and the remainder were made on relatively thick expanding flakes. Where the platform and positive bulb are preserved, they invariably occupy the proximal and ventral positions on the tool respectively.

Of the complete specimens, three outline morphologies were observed: rectanguloid (16), trianguloid (6), and ovoid (2). One of the rectanguloid specimens has a rectangular stem formed by marginally unifacially retouching the proximal and lateral margins. The two ovoid specimens, the largest endscrapers (Figure 49 n,o) also have a stemmed appearance as they have relatively long tapering rounded ends and retouched lateral margins. Lateral edge grinding is not present however. These two artifacts are of interest because they were from relatively deep stratigraphic contexts. One of these (Figure 49 n) a particularly well made symmetrical endscraper of a patinated chalcedony, bears remarkable similarity to a slightly smaller "very outstanding specimen" recovered at the Long Creek site in Saskatchewan in a context dated 2693±150 B.C. (Wettlaufer and Mayer-Oakes 1960).

Two of the rectanguloid endscrapers have straight distal working edges, otherwise the distal edges are convex. Transverse cross sections are either plano-convex, assymetrically biconvex, or planotriangular, and most have distally skewed plano-covex or plano-triangular longitudinal cross sections.

Microflaking or "nibbling" retouch was observed on all of the specimens interpreted as having use wear (24), accompanied by either edge rounding (5 specimens), ventral microflaking (4), edge rounding with transverse striations (3), or rounding with polish (2). One of these latter specimens had bright polish restricted to a thin band along the edge similar to that described by Brink as characteristic of use on a soft hide (Brink 1978). Ventral microflaking is an attribute associated with working bone (Brink 1978, Broadbent and Knutsson 1975). Striations were quite well developed on three endscrapers (Figure 50), an attribute

Figure 49: Endscrapers.

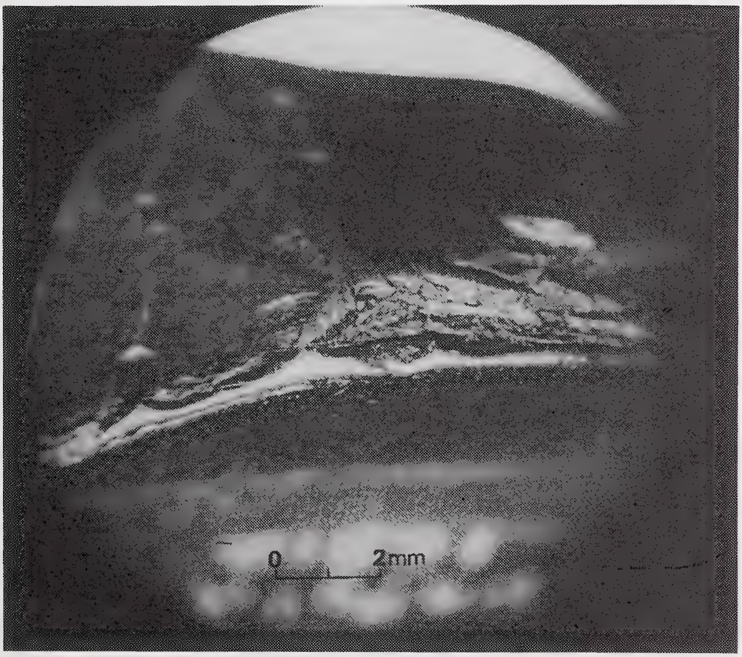

Figure 50: Detail of edge wear on endscraper #16812 (Figure 49e above).

which may be a result of scraping a silty surface; a condition which one would expect of any material exposed for any length of time to the wind and dust at Head-Smashed-In.

The raw materials represented in the endscraper category include: cherts and chalcedonies (19), one of which is a relatively large decortication flake of Knife River Flint (Figure 49 k); fine grained silicified sediments (7), silicified wood (1), and quartzite (1). A summary of endscraper attributes are provided below.

	Minimum	Maximum	Mean
Weight (gm)	0.9	29.9	3.9
Length (mm)	14.2	56.6	23.0
Width (mm)	8.1	31.2	17.9
Thickness (mm)	4.3	16.2	6.9
Edge Angle	60^0	100^0	77.8^0

8) Reamers (Figure 48 e) n=11

These are tools made on flakes which have marginal unifacial retouch on two opposing or adjacent edges and on opposite faces. Three of these are midsections with quadrilateral outlines, otherwise the remainder are essentially complete and have outline morphologies that are quadrilateral (4), triangular (3) or oval (1). Transverse cross sections are rhomboidal to biconvex. These tools are quite small, the mean weight is 0.9 grams, the mean length is 32.2 mm, the mean width is 12.7 mm, and the mean thickness is 3.2 mm. The retouched edges vary from slightly convex to slightly concave and have relatively steep angled edges averaging 70^0. Bilateral use wear is visible on all of these, and occurs as unifacial nibbling retouch which in three cases is accompanied by rounding. The wear on these tools suggests use in a rotary action. Eight of these are made of cherts or chalcedonies, two are obsidian, and one is quartzite.

9) Large Sidescrapers (Figure 51 a,d) n=2

These are both made of quartzite, have roughly rectanguloid planforms, and have thick rhomboidal transverse cross sections. Both specimens have one approximately straight lateral edge with steep marginal unifacial retouch forming a slightly uneven scraping edge. The larger specimen has one end broken off and the scraping edge has been dulled from use. No wear is evident on the scraping edge of the smaller artifact although a straight 15 mm long double bevelled edge section near one end on the opposite edge has been worn smooth.

Cat. No.	Weight (gm)	Length (mm)	Width (mm)	Thickness (mm)	Edge Angle
15370	143.7	84.1	52.7	26.2	80°
18930	38.9	59.6	31.0	15.6	75°

10) Large Bifacial Cutting/Scraping Tools (Figure 51 b,c,e) n=3

These are represented by three completely bifacially flaked quartzite tool fragments. Two of these (#1914 and #17506, Figures 51 e and 51 c respectively), are similar in that they represent broken ends formed by the junctures of an even single bevelled edge with a sinuous double bevelled edge, and have truncated assymetrically biconvex cross sections. The double bevelled edge on both of these is worn smooth. The other specimen (#9638, Figure 51 b) is an edge or convex end section which is uniformly double bevelled and sinuous, and is as well worn to a dull edge.

Cat. No.	Length (mm)	Width (mm)	Thickness (mm)	Weight (gm)
1914	61.4	35.8	13.0	30.0
9638	60.4	35.7	21.0	36.6
17506	49.4	34.4	17.4	38.8

11) Single Utilized Edge Flake Tools (Figure 48 f) n=90

These are pieces of debitage which have been used on one edge (n=87) or along the oblique angled juncture of two edges (n=3). The types of debitage selected for this utilization were predominantly flakes (45) and pieces of "non-diagnostic shatter" (34), with bipolar split pebble byproducts (8), cortical spalls (2), and a single tabular slab represented. The utilized portions of the tools are most frequently oriented parallel or obliquely to the longitudinal axis (63) and in no

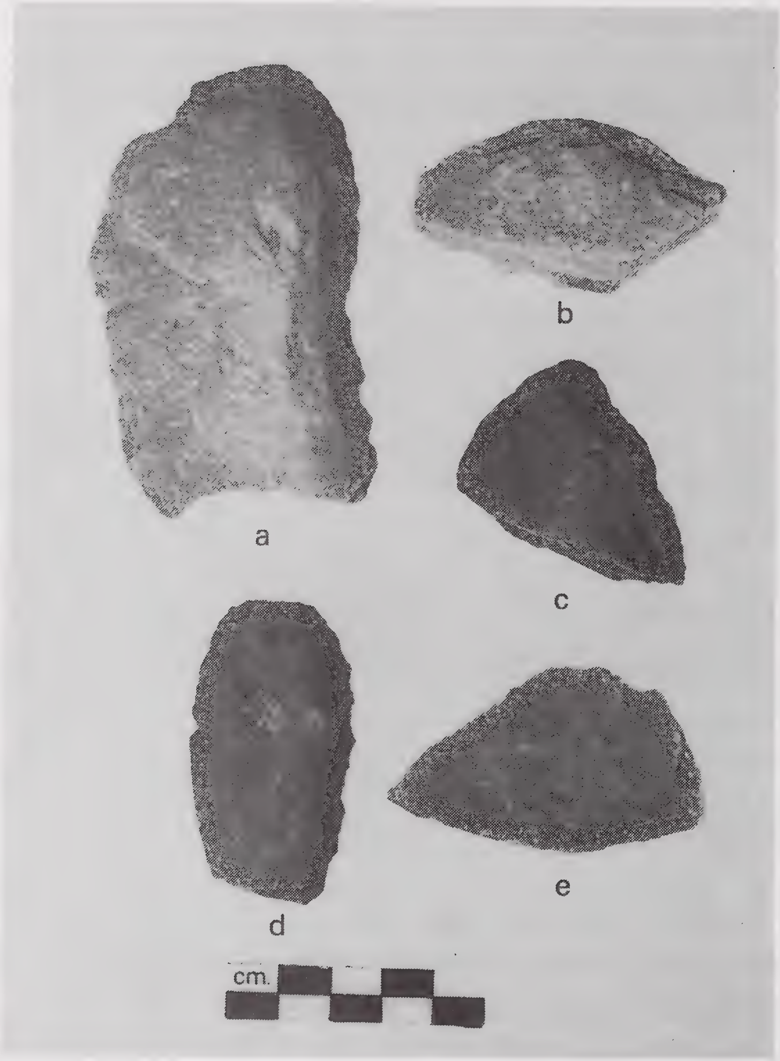

Figure 51: Large quartzite tools. Sidescrapers: a, d; broken cutting/scraping tools; b, c, e.

instance was the utilized edge restricted to one end of the tool (situated transversely). The shapes of the utilized portions are straight (22), convex (21), sinuous (10), concave(8), obtuse angled (3), irregular (9), or indeterminate (17). Edge angles form a unimodal distribution about the mean of 65°. Associated use wear is unifacial nibbling retouch or microflaking (64), which in sixteen cases is accompanied by a rounding or smoothening of the edge. Seven artifacts have a bifacially nibbled or crushed edge. In two of these cases (the largest tools in this category) the use wear is attributed to chopping. Ten of these tools have an edge which has been smoothened or rounded from use in an action perpendicular to the working edge. In one instance, a relatively large silicified siltstone flake, wear occurs along a smoothened and longitudinally striated lateral edge (Figure 52) which is interpreted as use associated with cutting or sawing. Otherwise, most of the tools in this category appear to have functioned as simple spokeshaves or scraping tools used or relatively hard material.

The raw materials selected for these expedient tools include cherts and chalcedonies (45), fine grained silicified sediments (17), quartzite (14), silicified wood (7), siltstone (4), limestone (1), quartz crystal (1), and obsidian (1). A summary of the metric attributes of these is as follows:

	Minimum	Maximum	Mean
Weight(gm):	0.1	263.4	13.1
Length (mm):	7.3	123.4	26.6
Width (mm):	5.4	77.1	18.4
Thickness(mm):	1.4	32.2	6.8
Edge Angle:	35°	100°	65°

12) Single Unifacially Retouched Edge Tools (Figures 48 g,h) n=84

These are tools or tool fragments with one functional unit consisting of a single unifacially retouched edge. Ten of these can be regarded as unifaces, on the others the retouch is restricted to the margins. The blank types selected were flakes (34) or flake shatter (42), bipolar split pebble byproducts (7), and one artifact was made from a pebble. This latter implement is a flattish elongate pebble of sandstone with crude unifacial retouch forming a 65° angled edge at one end. The other tools are mostly thin pieces of debitage with one margin retouched to form a single bevelled working edge. Only 23 of these are complete, otherwise a portion of the edge has been truncated by a fracture (31) or the remnant is an edge section truncated on two sides. Where the original shape of the working edge can be ascertained, it is straight (15), convex (13), sinuous (8), concave (4), serrated (1), or irregular (12). The most common orientation of the working edge is oblique or parallel to the long axis of the tool (58), with retouch oriented in other cases either transversely (4) or convexly from an end to the lateral edge (17). Edge angles average 67°, with most edges falling between 50° and 80°, and a peak at 90° is represented by nine cases. Observed wear was predominantly unifacial nibbling retouch (50). On eighteen of these this was accompanied by rounding of the high points and in two other cases this was associated with ventral scarring. In addition to these, six artifacts had bifacial nibbling retouch or crushing (observed only on straight edges) and on five artifacts the edge was rounded or smoothened. In these latter five cases no correlation was observed between edge morphology and wear. Use wear for these tools was interpreted as indicative of a scraping or spokeshave function, usually on quite hard substances. Raw materials used in this category include cherts and chalcedonies (44), silicified wood (13), fine grained silicified sediments (12), quartzite (10), obsidian (2), sandstone (1), argillite (1), and one unidentified coarse grained material. Metric attributes of these tools are summarized below:

	Minimum	Maximum	Mean
Weight(gm)	0.1	108.7	4.9
Length (mm)	9.1	98.6	22.6
Width (mm)	3.4	51.2	13.6
Thickness (mm)	1.4	22.3	5.1
Edge Angle	35°	95°	66.8°

13) Single Bifacially Retouched Edge Tools (Figure 48 i,j) n=97

These are either flakes with marginal bifacial retouch (38), or bifaces or biface fragments with one functional edge represented (59). As a result of the extensive flaking on most of these specimens the characteristics of the original blank are obscured. In 22 cases a flake was used as a blank and in one instance a bipolar split pebble was bifacially retouched. Artifacts in this category are mostly fragments, only eighteen are largely complete, twenty are edge sections, seven are midsections, thirteen are angular ends with a single retouched edge, and fifteen are rounded bifacially retouched tool ends broken either transversely or obliquely. Of the complete tools, ten are marginally retouched flakes with quadrilateral or triangular outlines and a single straight to slightly convex retouched edge situated obliquely or parallel to the longitudinal axis. The edge morphologies on the other tools are mostly straight or convex, five are sinuous, and none were concave. Edge profiles are either even (45), sinuous (42), or are indeterminate (10). Edge angles represent a bimodal distribution clustering at 50° and 70° with the overall mean of 61°. Wear was observed on 48 specimens, and occurred as bifacial nibbling retouch (28), nibbling retouch accompanied by rounding (8), crushing (7), edge rounding or smoothening (4), and in one instance an edge was rounded and had longitudinally oriented striations. Where rounding of the edges occurred it was observed to be associated with the steeper edge angles represented. Raw material types used for this tool category are notably all hard siliceous relatively fine grained raw materials. Cherts and chalcedonies (54), silicified wood (18), fine grained silicified sediments (15), quartzite (7), and obsidian (3) are represented. A summary of metric attributes is as follows:

	Minimum	Maximum	Mean
Weight(gm)	0.1	10.5	1.0
Length (mm)	5.2	43.7	15.8
Width (mm)	3.6	30.2	11.2
Thickness (mm)	0.4	7.9	3.8
Edge Angle	35°	90°	60.1°

14) Multiple Retouched/Utilized Edge Tools (Figure 48 k) n=88

These are marginally retouched or utilized flakes (72), small non-classified bifaces (1) or biface fragments (11), or unifaces made on flakes (4). Characteristics of these subgroups are as follows:

Marginally Retouched/Utilized Flakes (72): Of these, forty seven are approximately complete flake tools and twenty five are fragments broken off larger tools, including tips (2), midsections (3), edge sections (3), and proximal or distal end junctures (17). Most of these have two retouched or utilized edges, seven have three retouched edges, and two have four retouched edges. Edge morphologies are straight to convex, with three concave edges represented, and these are oriented parallel to obliquely relative to the longtudinal axis. Most of the edges are unifacially retouched or utilized but seventeen have bifacially retouched edges which are either even (7) or sinuous (10) in profile. Edge wear observed includes nibbling retouch (46) which is often rounded as well (18), alternate unifacial or unifacial and bifacial nibbling (7), rounding or edge smoothing (8), crushing (2), or nibbling retouch associated with ventral scarring (2). Mean weight, length, width, thickness, and edge angles for these are 6.7 grams, 23.0 mm, 17.2 mm, 5.1 mm, and 64.9^{0} respectively. Raw materials represented include cherts and chalcedonies (47), fine grained silicified sediments (7), quartzite (8), silicified wood (6), siltstone (3), and sandstone (1). One of these, a silicified siltstone, is a bipolar split pebble fragment, otherwide these are flakes or flake shatter.

Bifaces (12): All but one of these are fragments of small tools; tips (3), midsections (2), bases (1), and proximal or distal junctures (5) are represented. The complete specimen is a thin quadrilateral flake bifacially retouched on all four margins. The other tools in this subgroup have bilateral retouch, in all but one case this is bifacial and forms an either even or sinuous profile. One edge is crushed otherwise use wear was observed to be microflaking only. Mean weight, length, width, thickness and edge angles for these are 1.5 grams, 26.7 mm, 14.3 mm, 4.6 mm, and 58.3^{0} respectively. Raw materials represented include cherts and chalcedonies (7), quartzite (1), silicified wood (1), and fine grained silicified sediments (3).

Unifaces (4): These are flakes which have been unifacially retouched to form two straight to convex single bevelled edges oriented parallel to obliquely relative to the longitudinal axis. These are approximately complete and outline forms represented are oval (1), triangular (1), or quadrilateral (2). Use wear observed includes microflaking (2), microflaking witn ventral scarring (1), and edge crushing (1). Mean weight, length, width, thickness and edge angles for these are 2.3 grams, 23.3 mm, 16.7 mm, 6.1 mm, and 55^{0} respectively. Raw materials include chert or chalcedony (2), silicified sediment (21) and quartzite (1).

Ground Stone and Unmodified Stone Tools

1) Hammerstones (Figure 53 a-c) n=4

Four complete pebble/cobble hammerstones are represented in the assemblage. Three of these have a single battered end, presumably the result of hard hammer percussion; the other has extensive battering along one projecting lateral margin (#19049)*. All were recovered from the uppermost arbitrary 10 cm level, one from Unit 10 in Area 1 (#1935), two from Unit 4 in Area 2 (#17427, #17460), and one from Unit 6 in Area 2 (#19049). It is perhaps no coincidence that a relatively large number of cores, more than a third of the total sample, were recovered from the unit in which two hammerstones were found. A summary description of the hammerstones is provided below:

Cat. No.	Weight (gm)	Length (mm)	Width (mm)	Thickness (mm)	Material
1935	76.3	66	27	22	Sandstone
17427	119.7	58	42	41	Quartzite
17460	377.1	60	70	46	Quartzite
19049	425.5	95	67	55	Quartzite

*This latter artifact is as well crazed, a condition associated with rapidly cooling a hot rock in water.

2) "Pestles" (Figure 53 e,f) n=2

Two pestle-like implements were recovered from level 1 in Unit 4, Area 2. One of these (#11550, Figure 53 e) is the broken end of what appears to be a ground stone cylindrical roller with a rounded end. It

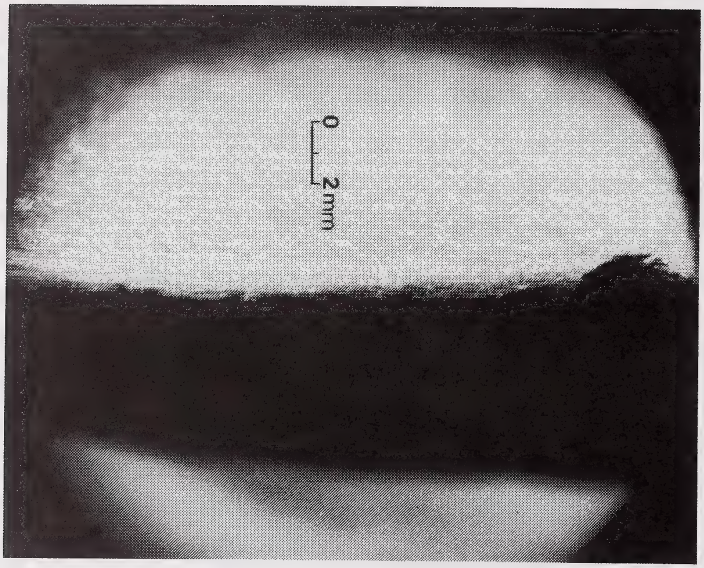

Figure 52: Detail of linear striations and rounding of a utilized edge on a silicified siltstone flake.

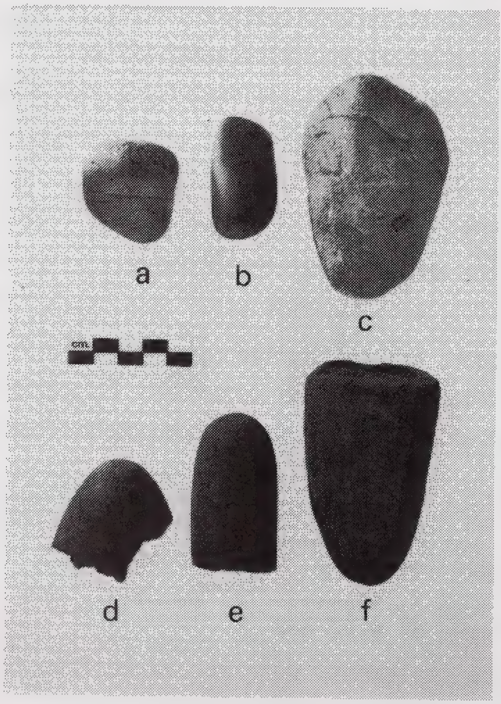

Figure 53: Ground or unmodified stone tools. Hammerstones: a-c; maul/pestle fragment: d; pestles: e, f.

measures between 34 mm and 36 mm in diameter, has an incomplete length of 65 mm and weighs 141 grams. It is made of the sandstone which outcrops at the site, which has been ground to a smooth symmetrical form. The intact end has been slightly pecked suggesting a presumably secondary use as a hammerstone, possibly subsequent to breakage.

The second "pestle" (Figure 53 f) is a conoidal shape formed from a coarse metamorphosed sandstone cobble. It weighs 348.7 grams, is 91 mm in length, and has a maximum diameter of 54 mm. The wide end has been crushed flat, and small irregular chips have been knocked off the edges. The shaft tapers to a blunt end which has also been pecked.

3) Choppers (Figures 36 b, 54 b) n=1

One of these (#17288, Figure 54 b) is a weathered thin tabular slab of the local sandstone which has been broken on two adjacent margins to lend a quadrilateral form to this implement. One of these breaks has partly truncated a relatively long, slightly convex edge, which has been battered. The flake scars crushed off this edge are now somewhat weathered. The second chopping tool (#5132) is a small fist sized quartzite cobble with a wedge shaped cross section. An approximately straight edge on the thin end has been crushed removing small flakes from either face. The other chopper (#11935, Figure 36 b) is a firebroken segment of a basalt cobble with a rectangular planform and triangular cross section. The blunt edge formed by the juncture of two flat cortical surfaces has been crushed.

Cat. No.	Weight (gm)	Length (mm)	Width (mm)	Thickness (mm)
5132	282.7	85	69	39
11935	110.7	65	39	34
17288	751.4	161	107	33

The dimensions of this artifact are 161 mm long, 107 mm wide, 33 mm thick, and weighs 751.4 grams.

4) Grooved Maul (Figure 54 a) n=1

A solitary maul was recovered from the surface a few hundred meters north of the spring channel. It is made from a coarse pink quartzite

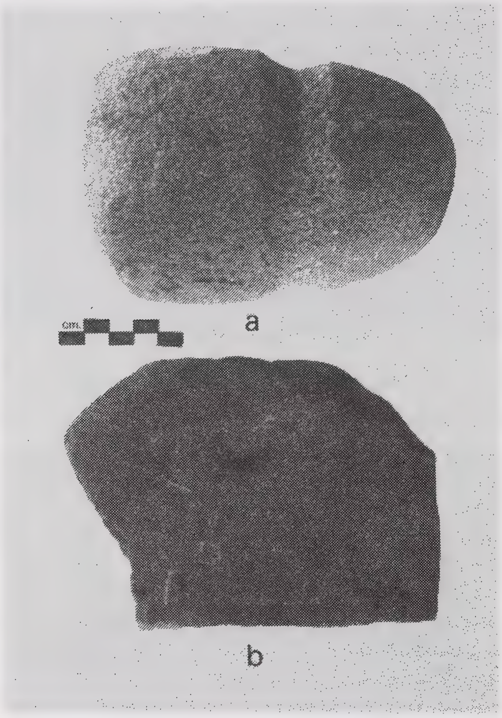

Figure 54: Ground or unmodified stone tools. Grooved maul: a; sandstone slab chopper: b.

cobble with a ovoid planform. The wide blunt distal end has been battered almost flat, removing the cortex from this area. A 30 mm wide groove has been pecked around the cobble to a depth of 4 mm to 5 mm, and is positioned just proximal to the middle. The overall length is 148 mm long, 105 mm wide (or high), and 68 mm thick, with a weight of 1,538 grams. The pecked surfaces have been weathered smooth and a thick crust of calcium carbonate adhers to one face suggesting this artifact has been lying in situ for a considerable time.

5) Maul/Pestle Fragment (Figure 53 d) n=1

A firebroken end of what appears to have been a blunt conoidal end of a ground stone implement. It is 44 mm in length, has maximum diameter of 49 mm, and weighs 109.6 grams. The raw material is a coarse textured igneous rock.

Discussion

The interpretation of the lithic assemblage recovered during the 1983 field season at Head-Smashed-In is restricted by both the widespread discontinuous nature of the largely exploratory testing program and a lack of cultural stratigraphy. The analysis was geared toward providing some insight into the activities represented in the processing area associated with the bison jump, and to provide an inventory of cultural materials to facilitate comparison with other northern plains archaeological sites. Due to this latter consideration, special emphasis was placed on the analysis of projectile points as these are generally regarded as being particularly sensitive temporal and cultural indices. Some difficulty was encountered in trying to "type" these as several aberrant specimens occurred which did not neatly fit into existing typological schemes. It may be presumptuous to even try to type many of the projectile points recovered from a multicomponent non-stratified context such as that represented in the camp/processing area at Head-Smashed-In. The possibilities of projectile point variability should logically be greater in a campsite or processing area than in a kill site where the primary functional context is the dispatching of animals with complete tools designed for that task. At the Vore Site, for example, Reher and Frison note the similarity of the points recovered can be partly accounted for by their "functionally restricted context" (Reher and Frison 1980:100). At a campsite and processing area however, a multitude of factors could introduce variability which might never be understood by the archaeologist. It is at such an area where toolmaking would cause undesirable preforms or accidently broken projectile points to be discarded. Somewhere the craftsman, whose skill is manifest in often beautiful products, had to learn his art by trial and error, producing a potential variety of forms quite dissimilar to the intended mental template. Such practice could introduce new variation into an otherwise typologically homogeneous single component assemblage. Too often point typologies assume that the artifacts recovered were necessarily "diagnostic". Further variation can be accounted for by difficulties in working disparate raw materials, by idiosyncratic peculiarities or ownership traits, or by variations necessitated by function. Confidence in interpreting these confusing factors could partly be ameliorated by considering use wear and functional context. It is suggested here that the possibility of isolating these critical factors is reduced in a campsite and processing area.

As mentioned previously, the projectile points found in the processing area are variable in terms of both style and raw material, and display different wear and breakage patterns. Some of the projectile points appear to have been made _in situ_ and are found associated with debitage of the identical raw material type suggesting that these were broken during manufacture. Future research at Head-Smashed-In may include refitting analyses to help quantify this observation. If the triangular points recovered here are interpreted as preforms as the analysis would suggest, the areal distribution of these might support an _in situ_ manufacture of these as well. The only triangular point made of non-local materials, an obsidian specimen, is also the only one which has any indications of use. The distribution of the triangular points is dissimilar to that of the other projectile point categories; 28 of the 30 triangular points recovered are from Area 2, a higher relative proportion than is exhibited by the other arguably more extensively developed specimens. In Area 2 primary reduction is well represented and is proportionately better represented both in the number of cores and primary decortication by-products than Area 1.

Our review of the literature indicates that the number of cores recovered in the processing area at Head-Smashed-In this year is greater than at any other communal bison kill site in the northern plains. Cores may be poorly represented elsewhere because:

a) there is often a disproportionate bias in sampling of kill deposits at the expense of the peripheral processing or campsite areas where logically one would expect to find more use for cores.

b) there is a real lack of primary reduction in processing areas due to a largely curated, portable tool kit.

c) the most prevalent core type found at Head-Smashed-In, the bipolar split pebble cores, have been either not recognized or have been misinterpreted as being pièces esquillées or wedges.

The important distinction between bipolar cores and pièces esquillées has only received recognition recently (Hayden 1980), and it is not unusual to see artifacts illustrated as pièces esquillées which are clearly bipolar cores. A re-examination of these assemblages would no doubt indicate a better representation of lithic reduction than was previously thought to exist.

The substantial representation of cores at the Head-Smashed-In processing site is significant because it contrasts sharply with the data from other Plains bison kill sites. At the Piney Creek jump in Wyoming, for example, Frison (1967) reports on a lithic assemblage of thousands of pieces including a wide range of functional items and not a single core. Based on similar experience at numerous other sites Reher and Frison (1980:127) are led to postulate a model to account for the general paucity of cores and primary manufacture detritus at northern Plains kill sites. This model states that because major kill events were well planned events, the practitioners would "gear up" by producing the requisite tool kit in advance. Thus few items of tool manufacture should be found at the major communal kills:

> preparation for a kill season included a stop at a quarry offering superior material where points and large tool blanks were prepared; the tools were reduced slowly and sparingly at the kill. Sharpening flakes and completely worn out tools constitute most of the remaining evidence (Reher and Frison 1980:127)

Clearly, much of the H.S.I. 1983 assemblage conforms to the predictions of the model, but the large number of cores recovered suggests that the model should be expanded. "Gearing up" is demonstrated at Head-Smashed-In by a large number of predominantly well made tools, mostly projectile points, and small pieces of associated debitage of exotic materials. This component of the assemblage however, was complemented by the addition of relatively local materials brought to the site in the form of complete pebbles or cobbles. These were reduced in situ to provide tools for expedient use. Transporting the raw materials in this form can be viewed as an efficient and convenient means of bringing a portable tool package to the site as all of the resultant by-products of core reduction could be available for use. This practice would serve as a means of rapidly augmenting a portable curated tool kit with expedient tools in the event of a communal hunt. It would seem, that given the inherent uncertainties of large communal kills, such as not knowing how many animals are to be killed, it would be prudent to have on hand a supply of raw material for tool production, especially at sites such as H.S.I. where no suitable stone is immediately present. It is noteworthy that although no cores were recovered at Piney Creek, a cache of 84 large flakes were found which Frison thinks were used as a tool supply (Frison 1967:17).

The bulk of the lithic assemblage from the 1983 excavations at H.S.I. is heavily dominated by small tools and flakes derived from small tools. Conspicuously absent or rare are large cutting or chopping tools which we would have assumed would form an important component of bison butchering and processing. The scarcity of these tool types may be due to:

a) inadequate sampling of the processing area.
b) the genuine lack of use of these tools in bison processing at H.S.I.
c) the removal of these tools from the site by the hunters after processing was completed.
d) the use of these tools at the immediate kill site to disarticulate the carcasses and not at the processing site.

We cannot yet fully evaluate these options, but there is evidence to suggest some truth to option "d" in that Reeves (1983b) reports on a sizeable assemblage of heavy tools (choppers) and coarse quartzite flakes from the kill site excavations. Thus, the tasks requiring these large cutting and chopping tools may have primarily been conducted in the immediate kill area. However, Reeves goes on to state that in his excavations of the camp/processing area; "the principle artifacts were numerous heavy stone tools," and; "most of the stone cores and waste flakes at the camp had come from large, coarse-grained quartzite cobbles; little fine-grained chert waste was found." (Reeves 1983b:130-135). Considering that chert debitage accounted for 60% of our sample, and the near absence of heavy stone tools, the contrast of our results with those of Reeves is striking. At present we are at a loss to explain this dichotomy and can only suggest that further excavations in the camp/processing area are needed to clarify the situation. Based on the results of the 1983 exavation, however, the lithic assemblage in processing area can be characterized by a large proportion of mostly small retouch and resharpening flakes, utilized and retouched flake tools, formed tools - especially projectile points, and bipolar pebble cores.

FAUNAL REMAINS

Introduction

The faunal assemblage from the 1983 excavations consists of 1412 taxonomically classified elements and 42,793.8 gm of fragmentary bone identified only as large mammal. While these two figures are not directly comparable, well over 90% of the material (by count) belongs to the latter category.

Identified material consists of Bison (58.49%), Rabbit or Hare (9.15%), Dog or Wolf (1.49%), small rodents (eg. Pocket Gopher, Richardson's Ground Squirrel .85%), Mule Deer (.21%), Beaver (.14%), Fox (.1%), Bird (.1%), Fish (.1%) and 29.64% classified simply as Artiodactyla (eg. Bison, Elk, Deer, Moose), (Table 6).

The bone is in relatively poor condition. Most of the assemblage consists of splinters or small scraps of bone which have resulted from natural physical breakdown. Burnt bone is represented sparsely but remains unquantified as no pattern could be discerned during excavation.

The faunal analysis is divided into 9 major sections. The first section explains the methods used to excavate the faunal assemblage, while the remaining sections contain the results and summary of the analysis. These sections are headed: 1) Excavation Techniques; 2) Bison; 3) Bone processing; 4) Bone tools; 5) Canids; 6) Other Species; 7) Worked Shell; 8) Unidentified Remains and; 9) Summary.

The 1983 field research design was oriented toward mitigation and preliminary exploration of the camp/processing area. This collection method was not designed to allow extensive analysis of the faunal material as it relates to the past lifeways of the peoples using Head-Smashed-In.

Discussion focusses on the condition and distribution of bison bone elements/segments and some space is devoted to food processing techniques associated with the features located on the site.

Canids are discussed in some detail. Canid remains were represented by large fragments of the skull and mandible which permitted some questions to be investigated about species classification and domestication.

Table 6

Number of identified specimens by Area of mammal remains at HSI

AREA 1	NISP	%
Bison bison	66	18.97
Identified to Species	66	18.97
Lepus	68	19.54
Spermophilus	1	.29
Canis	5	1.44
Identified to Genus	74	21.26
Geomyidae	2	.57
Leporidae	67	19.25
Scuridae	1	.29
Identified to Family	70	20.11
Artiodactyla	138	39.66
Identified to Order	138	39.66
TOTAL NISP for Area 1 = 348		

AREA 2	NISP	%
Castor canadensis	2	.22
Spermophilus richardsonii	1	.11
Zapus princips	1	.11
Bison bison	604	68.25
Identified to Species	608	68.70
Canids	8	.90
Spermophilus	3	.33
Identified to Genus	11	1.24
Identified to Family	0	0
Artiodactyla	265	29.94
Rodentia	1	.11
Identified to Order	266	30.05
TOTAL NISP for Area 2 = 885		

Table 6 (continued)

AREA 11	NISP	%
Vulpes vulpes	1	.76
Odocoileus hemonius	2	1.54
Bison bison	115	84.62
Identified to Species	116	86.92
Canis	3	2.34
Identified to Genus	3	2.34
Identified to Family	0	0
Rodentia	2	1.54
Artiodactyla	7	5.38
Identified to Order	9	6.92
TOTAL NISP for Area 11 = 128		

AREA 12	NISP	%
Odocoileus hemoinus	1	1.96
Bison bison	38	74.51
Identified to Species	39	76.47
Canis	5	9.81
Identified to Genus	5	9.81
Identified to Family	0	0
Artiodactyla	7	13.73
Identified to Order	7	13.73
TOTAL NISP for Area 12 = 51		
TOTAL NISP for Site = 1412		

Very few species were recognised other than Bison bison and Canis sp. The majority of these other species are regarded as intrusive small mammals and receive only cusory attention.

Unidentified remains composed the largest category of the assemblage due to active adverse taphonomic factors. These fragments have been presented in tabular form and discussed briefly.

Excavation Techniques

An attempt was made to collect all faunal material. This material was bagged with a provenience of Area, Unit, Quadrant, Subquadrant and Level. Excavators had picked all bone fragments/elements from each subquadrant of the excavation units. All of the matrix was screened through 1/4" mesh and all faunal material caught in the screens was collected.

Identifiable elements/fragments *in situ* which looked fragile were wrapped in aluminum foil as an attempt to prevent deterioration of the bone before a positive identification could be made in the laboratory. Particularly fragile, valuable elements were coated with dilute white glue before removal from the excavation unit.

Bison bison

The faunal assemblage for the 1983 field season at H.S.I. included 823 identified elements/fragments of bison. These parts contributed 78.98% of the total identified pieces from all excavations. If local and presumably naturally occurring rodent remains are excluded from this total NISP (number of identified specimens) count, bison remains account for 82.3% of the assemblage.

Ideally analysis of the bison remains would attempt to establish temporal/seasonal trends in herd composition and test hypotheses pertaining to cultural activities which took place at the jump. Temporal and/or cultural variation in butchering techniques, season of the kills, quality versus quantity butchering, degree of marrow extraction and bone degreasing as food procuring techniques are some of the subjects which should be investigated given the virtually limitless faunal universe to be sampled at Head-Smashed-In.

Unfortunately most testable hypotheses generated to elucidate the nature of these prehistoric activities and processes are thwarted by two major factors affecting the campsite area: 1) a lack of discernible stratigraphy and; 2) the action of adverse taphonomic processes. A third variable, excavation strategy, also reduced the amount of potential information from the site excavation. The major goals of the 1983 field season were mitigation and primary exploration of the site to determine site boundaries and possible activity areas. Given the factors of limited manpower and time for such a large site, this resulted in judgementally placed units spread over a very wide area. This research design does not allow the use of any but the most robust, non-parametric statistical tests. It should be emphasized that the purpose of the 1983 excavations was not to recover a faunal sample suitable for application to various problems in Plains Prehistory. Hence the intent of this section is to present an accurate description and discussion of the recovered faunal material, and to initiate discussion of some of the major problems in faunal analysis of communal kills to which we think future research at H.S.I. can be directed.

While we can be reasonably sure that the vast majority of bison remains are a result of the operation of the jump, little remains of the cultural patterns which led to the initial procurement and subsequent processing of the bison. This is due largely to the poor preservation of most of the bone, and the adverse factors of compressed stratigraphy and taphonomy mentioned above. Spatial and temporal patterns have been altered or erased due to deflation of the soils and trampling by subsequent users of the jump and by cattle; and from historic alteration caused by quarrying and mining of the bone bed and pot-hunting. Patterns on and between the bones have been lost due to extensive weathering (Behrensmeyer 1978).

It is necessary to address these agents of destruction. Following that some general remarks can be made about spatial distributions, and an areal description can be given of the bison remains. More specific cultural activities, such as butchering techniques, marrow extraction and bone degreasing merit discussion, but little supporting evidence can be gleaned from the faunal assemblage.

This section is divided into three segments: 1) Agents of Disturbance and Destruction; 2) Description and Analysis of the Bison Remains and; 3) Bone Processing.

1) Agents of Disturbance and Destruction

Disturbance in this context refers to loss of information about spatial and temporal patterning, and destruction due to extensive post mortem degeneration of the bone.

The spatial and temporal patterns resulting from the initial prehistoric activities at the site have been disturbed by man and nature. It is known that 20th century activity on the site has been relatively intensive, given the accessible location of the jump. The face of the jump has been quarried for sandstone and the site has been the target for pot hunters, particularly the bone bed/kill site. Natural disturbance comes from slumpage and topple of the cliff face; seasonal runoffs over both the site surface and in the spring channel; and lateral and vertical movement of bone by rodents. The extent of slumpage and topple can be seen in the amount of sandstone from the cliff distributed throughout the soil. This sandstone is more common the closer one comes to the base of the cliff. Excavations along this base area show slumpage and topple to be extensive but localised. Rodent activity is believed to be extensive, as evidenced by the large number of rodent burrows encountered in our excavations.

Agents of post mortem bone alteration have been categorized as taphonomic (Efremov 1940). Taphonomic agents can be subdivided into biostratinomic (preburial effects), and diagenetic (post burial) effects on bone. Biostratinomic agents have played the major role in loss of information about the bone at Head-Smashed-In. Diagenetic factors, such as chemically destructive soils, seem to have been less significant. Quick entombment of bone is usually an effective preserving mechanism, as evidenced by the quickly buried and better preserved faunal material excavated from the bone bed of the kill site (Reeves 1978, 1983b). The most active destructive mechanisms appear to be heat/cold, wet/dry cycles to which bone lying on the surface is subjected. Trampling of the exposed and degrading bone by prehistoric and historic ungulates, and by hunters occupying the site are also believed to be important causes of bone destruction.

Bone destruction takes the form of physical, not chemical, breakdown. This process has been divided into stages (Behrensmeyer 1978) starting with 1) bone cracking parallel to the fibre structure, and advancing through 2) flaking, 3) weathering of compact bone, 4) splintering, and finally 5) bone falling apart in situ. Most bone at Head-Smashed-In displays at least some degree of physical weathering (Figure 55), with the majority falling in stage 5, as demonstrated by the enormous quantities of small, unidentifiable fragments . Bone escaping weathering can be assumed to have been buried quickly or protected by surface microenvironmental variation. As a rule such bone was only recovered from the subsurface pit features. During the 1983 field season it was noted that freshly exposed bone in good condition would acquire cracks and splits within days of exposure.

These physical agents have changed the nature of the faunal assemblage at Head-Smashed-In. Bone which has the highest probability of surviving these weathering agents is that displaying very dense, hard, compact structure. In the bison skeleton these bones are best represented by the phalanges, carpals, tarsals and teeth. A comparison of NISP for this compact bone versus less dense bone would be an unreliable indicator of taphonomic survivability due to an expected disproportionate representation of certain anatomical parts after primary and secondary butchering (Binford 1978, 1981; Speth 1983). Binford (1978) predicts the lower limb and toe bones to be common survivors of kill episodes due to their low food utility and the difficulty of processing these elements. It was noted, with the exception of teeth, that when dense elements survived they were found in good to excellent condition. Teeth, although the hardest tissue in the body, are very brittle and tend to exfoliate when subjected to fluctuations in temperature. Hence, great numbers of teeth fragments were recovered, with few complete teeth observed.

Other evidence for the survivability of hard, dense bone is shown by the skull. When skull portions were identified it was the peterous bone which was represented to the exclusion of almost all other portions (49% peterous bone vs. 51% of all other skull fragments.) Since this very

Figure 55. Examples of bone weathering at HSI.

hard bone is surrounded by softer skeletal material, and not easily separated, it would seem that this soft material is eroding while that hardest portion of this area remains intact. Thus while phalanges, carpals and tarsals are not particularly useful as indicators of taphonomic survival, the high percentage of peterous bones relative to other skull parts is seen as evidence of severe taphonomic breakdown of bone. This argument is augmented by the fact that the skull is of little food utility to both humans (Binford 1978) and other animal scavengers (Brain 1981; Haynes 1980).

Another agent of both disturbance and destruction is carnivore/rodent activity. Carnivores are represented at this site by canids. Rodent remains include pocket gophers (Thomomys talpoides) and ground squirrel (Spermophilus richardsonii). Direct evidence for these animals' effects on the assemblage through gnaw marks is scarce due to the poor condition of most bone, but all are known to move and destroy bone. Canids are the potentially most destructive of this group but the extent to which they have destroyed any bison remains depends on the animals' hunger. Bones are the last choice of these animals if faced with other portions of an animal carcass (Haynes 1980), but any type of feeding can result in the movement of the remains. Burrowing rodents of the area have contributed to a downward and lateral movement of some of the remains. Ideally we would identify that faunal material which exhibits evidence of carnivore/rodent alteration and exclude it from subsequent discussions of cultural utilization and patterning of the remains. Unfortunately the poor preservation of most bone precluded this segregation.

2) Description and Analysis of Bison Remains

All bovids examined were found to belong to the genus Bison. The site and surrounding area are currently used as cattle range therefore the presence of Bos is possible and morphologically distinguishing characteristics used were based on Olsen (1960). The poor condition of the remains did not warrant wading into the mire of bison taxonomic classification. Radiocarbon dates and lithic artifact styles indicate the processing and campsite remains date primarily from the late prehistoric to historic period allowing a tentative classification of our materials as Bison bison, the extant species. Head-Smashed-In lies close to the historic range for Bison bison bison but remains in the present territory of Bison Bison athabascae. Due to the possibility of a shift or overlap in ranges during the late prehistoric period, no subspecific classification will be forwarded.

As mentioned earlier, the assemblage from the processing area has been greatly modified by physical biostratinomic forces, and the cultural patterning has been impacted both naturally and by modern cultural activities. As a result, discussion of the bison remains must be limited to general descriptive remains and coarse grained, low resolution analysis.

In setting the scene for a description of the bison remains, a brief overview of the site will be presented in so far as it pertains to the faunal assemblage. The site is described in much more detail in other sections of this report.

The site can be summarized as consisting of the kill site below an east facing cliff and a camp/processing area to the north, east and south of this kill zone. Extensive excavation was made by Reeves of the bone bed accumulation in the kill site during the summers of 1965-66 (Reeves 1978). The results of the faunal analysis of these bone bed deposits (Lifeways 1979) indicated a high proportion of long bones, although all portions of the skeleton are represented. The bison remains are generally fragmented and the Lifeways report suggests marrow extraction as the responsible cultural mechanism. Throughout this report it is stated that these areas, the slump blocks below the cliff face, are secondary butchering areas.

Secondary butchering refers to the stripping of muscle mass from high meat yielding portions of the animal after these portions have been removed from the carcass. A secondary butchering area is identified by an abundance of skeletal material associated with these high yielding portions and absence or low frequency of low utility portions.

We question the accuracy of the identification of Reeve's excavation area as a place where much secondary butchering was conducted. The topography of the area - that is, the fairly steep slope of the slump block deposits below the cliff - makes this an unlikely place for this activity. The fact that killing and primary butchering of possibly hundreds of animals occurred on these slump blocks adds to our skepticism, as it seems that an entirely new area to work would have been desirable if not requisite. Finally the absence of features and the general nature of the artifact assemblage at the kill site are suggestive of primary rather than secondary butchering. We would argue that most secondary butchering would have taken place in the prairie level camp/processing area. This model is consistent with other excavated bison jumps in the northwestern Plains (c.f. Frison 1974 ,1978).

The areas investigated during the 1983 Head-Smashed-In field season lay to the east and south-east of the kill site. These were designated as a camp/processing area, and contain an enormous quantity of bone extending 450 m south of the kill site and beyond the boundaries of excavation to the east and north. A plowed field approxmately 500 m southeast of the kill site shows large amounts of bison bone. The northern extent of the deposits remain unknown.

The area directly east of the bone bed (Area 2) contains a spring channel which bisects this region into northern and southern halves. The southern half of Area 2 is apparently the richest region of the site. Three excavation units placed here revealed bone in a thick layer extending from the surface to a depth of 20-30 cm. Formation of these compacted and unstratified deposits is no doubt due to a combination of minimal deposition, erosion of soil by deflation and water runoff, and repeated use of the site throughout the Late Prehistoric period.
The northern section of Area 2, across the spring channel, while still richly endowed with bone and artifacts, appears to have been used less intensely. Density, as calculated by NISP, for bison bones per cubic metre excavated is 262.67 bones/m^3 for the south side of Area 2 and 40.38 bones/m^3 for the north side. Bone was distributed throughout the upper 20 cm on the north side of the spring channel, but was not dense enough to form the 'bone carpet' characteristic of the southern side. One factor which may be responsible for this discrepancy between north and south is terrain. The southern portion of Area 2 is flatter and slightly higher than the northern side. Also, with the prevailing winds from the southwest, the south side of the spring channel would lie upwind of the kill site. This would likely offer an advantage to the prehistoric occupants given the natural decomposition following a successful jump.

Excavation information is summarized below:

Area	Number of Excavation Units	Volume Excavated	NISP (bison)
1	10	12.95 m^3	66
2	9	6.70 m^3	604
11	11	14.00 m^3	115
12	4	5.70 m^3	38
Totals for site:	34	39.35 m^3	823

The raw data for the 1983 excavations is presented in Table 7, with data presented in the form of bison skeletal element totals for each area and for the site. All bison elements were represented excepting the sternebrae.

The data was recompiled for variables (elements) and cases (areas). Area 1 is our own post-field construct which lumps all excavations associated with the development areas (i.e., Areas 1, 11, 12). The recombined areas will be referred to as analytic Area 1.

The raw data of element frequencies was recombined to represent sections of the bison. Skull and mandible counts were combined to represent the head; axis, atlas and cervical vertebrae 3-7 were combined as cervical vertebrae; ribs and sternebrae represented the chest area; radii and ulnas represented the midsection of the forelimb; individual carpals were treated as groups, as were tarsals; and all phalanges and sesamoids were combined to represent the foot.

Combining elements into small, discrete units has the twofold advantage of: 1) representing the bison in a manner closer to a living entity where elements operate as a unit and are used or discarded by the butcher as a unit and; 2) allowing more reliable statistical testing by elimination of some numerically empty or very small categories in the raw data.

These recombined analytic units were purposefully small to prevent the obscuring of any butchering patterns which may have been present. For example, if all skeletal elements from the foreleg of the animals were grouped as an analytic unit, a test for homogeneity may support the hypothesis of forelimbs being proportionally equal in Area 1 and Area 2. A closer examination may show a higher ratio of lower forelimbs in Area 1

Table 7

Number of identified specimens of Bison, by excavation area, and site.

	AREA 1	AREA 2	AREA 11	AREA 12	SITE TOTAL	BISON SITE % TOTAL
Skull	0	50	6	2	58	7.05
Mandible	1	20	1	2	24	2.92
Hyoid	0	1	0	0	1	.12
Atlas	1	1	2	0	4	.49
Axis	0	2	2	0	4	.49
Cervical Vertebrae	0	8	0	0	9	.97
Thoracic Vertebrae	1	22	0	2	25	3.04
Lumbar Vertebrae	2	12	0	1	15	1.82
Sacral Vertebrae	0	0	0	1	1	.12
Caudal Vertabrae	0	10	0	0	10	1.22
Ribs	8	77	2	1	88	10.69
Sternum	0	0	0	0	0	0
Pelvis	3	5	1	0	9	1.09
Scapula	3	19	2	0	24	2.92
Humerus	1	9	2	0	12	1.46
Radius	4	18	4	2	28	3.40
Ulna	0	10	1	0	11	1.34
Scaphoid	1	12	2	2	17	2.07
Lunate	1	11	3	0	15	1.82
Cuneiform Manus	2	6	5	0	13	1.58
Pisiform	1	3	0	3	7	.85
Magnum	3	17	3	0	23	2.79
Unciform	0	6	4	0	10	1.22
5th Metacarpal	0	1	0	0	1	.12
Femur	3	12	1	2	18	2.19
Patella	0	4	1	0	5	.61
Tibia	3	27	6	0	36	4.37
Lateral Malleolus	1	8	2	3	14	1.70
Astragulus	2	26	5	0	33	4.01
Calceneum	2	2	2	1	7	.85
Navicular Cuboid	0	14	3	0	17	2.07
Cuneiform Pes	7	16	2	0	19	2.31
1st Metatarsal	0	2	2	0	4	.49
2nd Metatarsal	1	0	0	0	1	.12
Metacarpal	1	13	4	0	18	2.19
Metatarsal	7	21	3	0	31	3.77
Metapodial	6	12	1	0	19	2.31
1st Phalanx	2	28	11	6	47	5.71
2nd Phalanx	3	36	18	7	44	5.35
3rd Phalanx	1	20	7	2	30	3.65
Proximal Sesomoid	1	25	7	1	34	4.13
Distal Sesomoid	0	18	0	0	18	2.19
TOTAL	66	604	115	38	823	97.61

and upper forelimbs in Area 2. Using smaller analytic units prevents this situation when butchering patterns for the site are unknown.

This recombined data is presented in Table 8 and a cumulative frequency graph (Figure 56).

An ethnographic account of Blackfoot 'heavy butchering' or butchering close to camp is given by Wissler:

> Assuming that the carcass was in camp, the procedure for buffalo or deer was about as follows: -- The fore quarters were removed by cutting down through the shoulder joints. Then cuts were made at the shins. The hind legs were cut off and the quarters cut at the hip joints. The back-fat was removed in broad bands. The breast and belly were cut away in one piece; then the short ribs, eight on a side, in two pieces; also two similar pieces of neck ribs. The parts of the loin containing the kidneys were taken next. The "boss ribs" (hump) were stripped. If there was a feotus it was tied up with the "boss ribs". The backbone was cut into two pieces. A chunk of meat from the rump and one from the neck were taken. The heart, tongue, brain, paunch and small intestines were taken. Sometimes the hoofs and some of the head meat were also taken. The marrow from the leg bones was usually eaten raw during the butchering (Wissler 1910:41).

A general description of the Plains Indians butchering practices is also given by Daniel Harmon, a later 19th century fur trader:

> The Natives generally cut up the body of an animal into eleven pieces, to prepare it for transportation to their tents, or to our forts. These pieces are the four limbs, the two sides of ribs the two sinews on each side of the backbone, the briskey, the croup, and the backbone. Besides these they save and use the tongue, heart, liver, paunch, and some parts of the entrails (Harmon 1911:287).

The close proximity of the camp/processing area to the kill site at Head-Smashed-In allows an assumption of the use of heavy butchering techniques to disarticulate the bison carcass. The camp/processing area would thus be the site of secondary butchering and further processing. The southern half of Area 2 of the camp/processing area is so close to the kill site that it is likely that occasional killing and primary butchering of bison who had escaped the carnage on the slopes above also occurred on the lower prairie level.

Using Wissler's discussion of "heavy butchering" as a guide, we would expect that the secondary butchering on the prairie level would be represented by remains of the hindlimb, rib and thoracic vertebrae elements/fragments; and skulls, mandibles, vertebrae, pelvic and rib

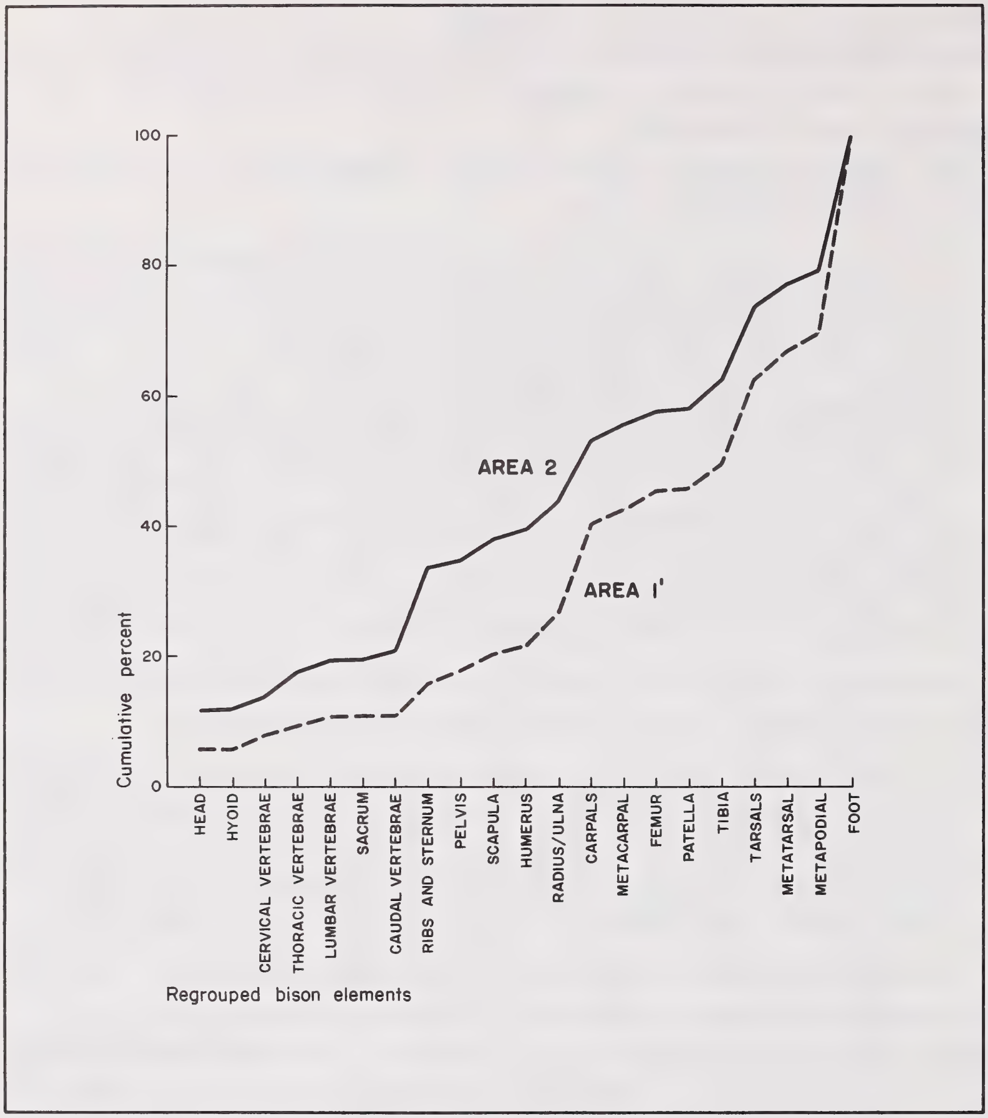

Figure 56: Cumulative frequency graph of recombined portions of the Bison skeleton by analytic area.

remains in the primary butchering area. Of course this is a very simplistic model for Head-Smashed-In because the camp/processing area was also the probable site of occasional primary butchering.

Comparing our assemblage to the above scenario, the 1983 bison assemblage has approximately 19% of elements (by NISP) associated with primary butchering and 81% of elements associated with secondary butchering. Ribs and thoracic vertebrae were discounted due to their association with both butchering processes. A bison carcass has about 40/60 ratio of primary to secondary butchering elements in a heavily butchered carcass. This ratio was derived assuming all axial elements of the skeleton excepting floating ribs as primary bone processing remains and appendicular elements plus floating ribs and thoracic vertebrae as secondary butchering elements. The hyoid, sacrum and sternum were treated as single units. Primary butchering proportions = 38.5% and secondary butchering elements = 61.5%.

As previously discussed, the 1983 faunal material represents a taphonomically altered assemblage. The probability is higher for the survival of hard dense elements. The majority of taphonomically resistant elements (ie. carpals, tarsals, phalanges) are members of the appendicular skeleton. In other words, the probability of identifying these remains from secondary butchering is greater than remains for primary butchering at Head-Smashed-In. In an attempt to account for this bias in the calculation of primary butchering versus secondary butchering elements in the camp/processing area, the tarsals, carpals and phalanges were removed from the counts and percentages were recalculated. Primary butchering remains accounted for approximately 26% of the assemblage and secondary butchering remains were close to 74%. When these figures are considered against a background noise of scavenging and fluvial actions, some of which is reducing the presence of secondary elements and introducing primary butchering remains from the upslope kill area, it seems very likely that the vast majority of bison related cultural activity was concerned with secondary butchering and food processing in the camp/processing areas as designated in 1983.

Areas 1 and 2 can be contrasted for distribution and density. It is expected that there would be a fall off of butchering and processing activity the farther one is from the primary kill site. Approximate densities can be computed by dividing bison NISP by volume of matrix excavated per area. This simple calculation yields a faunal density of 6.71 bison bones/m^3 excavated for Area 1 and 90.15 bones/m^3 for Area 2. If excavation units which showed possible contamination from the kill site due to soil slumping are eliminated from Area 2 (Units 21 and 5), density is increased to 133.49 bones/m^3. This dramatic increase is due to Unit 5, located on the slope of the kill site, being very bone poor, containing only three identified pieces.

Bone density is seen to be highest in the southern half of Area 2 and decreases to the north and south of this region. This fall off in density is probably due to uneven terrain in the north and distance from the kill zone in the south. The next step in describing the bison remains involves a comparison of the frequencies for areas of the bison between the two study areas. If different activities are being performed in each area we may expect this to be reflected in differential proportions of bones for each area. However, due to the alteration of the assemblage because of taphonomy and active geology we must evaluate any significant results in terms of these forces before ascribing them to cultural activities.

A statistical test of homogeniety, the G statistic, was used to determine if there was a statistically significant disproportion of particular groups of elements in Area 1 relative to Area 2.

The G statistic showed the proportion of analytic units in Area 1' to be significantly different from Area 2 ($G=X^2=286.11$, 41.401 p. 005 at 21 degrees of freedom). Examination of percentage frequencies of the analytic units (Table 8) shows the greatest differences to lie in a higher proportion of heads and ribs in Area 2 and carpals and phalanges in Area 1. Ribs were eliminated from this list because they breakdown into small fragments which are unidentifiable to a species level and, in the case of bison are easily confused with the dorsal spine of the thoracic vertebrae. The higher frequency of rib element/fragments for Area 2 is tempting to include but, perhaps, discretion is the better part of analysis.

The head is also arguably taphonomically susceptible but the validity of the disproportionate representation of this element between areas may

Table 8

NISP Totals, by analytic area, for recombined portions of the bison skeleton.

	AREA 1	%	AREA 2	%	SITE TOTAL	%
Head	12	(5.48)	70	(11.59)	82	(9.96)
Hyoid	0	0	1	(.17)	1	(.12)
Cervical Vertebra	5	(2.28)	11	(1.82)	16	(1.94)
Thoracic Vertebra	3	(1.37)	22	(3.64)	24	(2.92)
Lumbar Vertebrae	3	(1.37)	12	(1.99)	15	(1.82)
Sacrum	1	(.45)	0	0	1	(.12)
Caudal Vertebra	0	0	10	(1.66)	10	(1.22
Ribs & Sternebra	11	(5.02)	77	(12.75)	88	(10.69)
Pelvis	4	(1.82)	5	(.82)	9	(1.09)
Scapula	5	(2.28)	19	(3.15)	24	(2.92)
Humerus	3	(1.37)	9	(1.49)	12	(1.46)
Radius/Ulna	11	(5.02)	28	(4.64)	39	(4.74)
Carpals	30	(13.70)	56	(9.27)	86	(10.45)
Metacarpal	5	(2.28)	13	(2.15)	18	(2.19)
Femur	6	(2.74)	12	(1.99)	18	(2.19)
Patella	1	(.45)	4	(.66)	5	(.6)
Tibia	9	(4.10)	27	(4.47)	36	(4.37)
Tarsals	27	(12.33)	68	(11.26)	95	(11.54)
Metatarsal	10	(4.56)	32	(3.48)	31	(3.77)
Metapodial	7	(3.20)	12	(1.99)	19	(2.31)
Foot	66	(30.14)	127	(21.02)	193	(23.45)

easily be confirmed by examining the distribution of teeth throughout Area 1 and 2.

A X^2 test was used as a test of proportion between areas, using three variables; upper teeth, lower premolars/molars and lower incisors over two cases; Area 1 and Area 2. The results of the X^2 reject the hypothesis of unequal proportions of teeth between Area 1' and 2 (.06 7.815 = p .05 at 3 degrees of freedom). Evidently the head is present in Area 1' but is breaking down to an unidentifiable form. Alternatively the head may have been absent or poorly represented in this area and some mechanism is moving teeth into this area but, given the condition of the other skeletal remains from the site, it is more likely that heads are an unrecognized presence in Area 1.

The two remaining disproportionate analytic units, carpals and phalanges probably represent a real difference between Areas 1 and 2 as both analytic units consist of dense bone resistant to the taphonomic forces active at Head-Smashed-In. A very high proportion of this type of bone comes from two units, 5 and 6, of Area 11. They are located at the base of a steep slope uphill, very close to a small run off channel or spring head. The matrix is well stratified which is indicative of a slump area. Sandstone from the cliff face is distributed randomly throughout the units.

This situation is indicative of fluvial deposits and does not reveal a cultural activity centre. Carpals and foot elements are easily transported by water (Voories 1969) and resist breakage. It is not surprising to find deposits such as these at the base of a steep slope with a runoff located nearby. This deposit does show, however, that there may be a secondary kill site somewhere above these units, but it is also possible that these deposits have washed down from scavanged bone from higher levels.

This coarse analysis has shown that the level of cultural activity in the southern half of Area 2 is much more intense than elsewhere in the site. This situation remains the same even when units which show slumping, therefore secondary deposition of bone, are discounted from the Area 2 frequency counts for elements. Investigation of possible differential distribution of bone analytic units between areas rendered statistically significant results supporting a hypothesis of hetrogeneity.

However, these results are as likely to be the product of adverse taphonomic factors as they are to be indicative of a difference in cultural activities between areas.

Bone Processing

The analysis of the Bison bone assemblage recovered from the camp and processing area provides an interesting contrast with the kinds of remains that were derived from the kill site deposits (Lifeways of Canada 1979). These differences likely stem from the selection of particular portions of the Bison for further processing, which may have seen the discard of the cranium and axial skeleton at the kill site and transport of the major muscle mass, ribs and quarters to the camp and processing area. This is an idealized and grossly simplified picture of butchering practise and selection of meat units, and no doubt was modified depending on site specific circumstances (see Speth 1983). It does, however, appear to be corroborated by the faunal assemblage from the camp and processing area.

While much of the activity in the camp area was likely devoted to the stripping of meat, drying, roasting and boiling of meat portions it is probable that some time was spent in the processing of bone to obtain marrow and grease by-products. The archaeological evidence for such activities is thought to be manifest in the large numbers of broken elements and abundant fragmentary bone, FBR features, and the presence of presumed boiling pit features. While all of the necessary paraphenalia for bone processing would appear to be present at HSI, it is questioned whether such activity was always a necessary corollary of butchering large numbers of bison. Faced with the abundance provided by a mass kill and the need to preserve the meat prior to spoilage one may argue against the diversion of manpower, fuel, and particularly the time required to process bone for marrow and grease extraction (cf. Binford 1978). A review of the ethnographic and ethnohistoric sources pertaining to the Plains Indians was undertaken to better understand the circumstances under which bone processing was done, and what evidence might be anticipated in the archaeological record that would confirm the activity.

1) Ethnographic Record

Although a number of authors have noted that bone processing was done in the Plains (Wilson 1914, 1934; Turney-High 1937; Schoolcraft 1851-57; Flannery 1953; Cooper 1957), there are remarkably few details pertaining to the exact processes or materials involved. Notably absent were any specifics regarding settlement or subsistence parameters that coincided with bone processing activities. In some instances conflicting information was presented with respect to the kinds of bone utilized in bone processing (cf. Dorsey 1884; Densmore 1918). The upshot of the ethnographic and ethnohistoric literature review was that Plains groups certainly appeared to have engaged in bone processing activities, but it was unclear as to the timing, motivation or material remains that would accompany such an undertaking.

Expanding the literature search beyond the Plains area garnered an additional supply of data, but once again the detail was sadly lacking (Leechman 1951; Wallis & Wallis 1955; Fletcher & LeFlesche 1911). There was also some confusion in the terminology applied to bone processing, such as the synonymous usage of "bone grease", "marrow-fat" and "marrow grease", presumably to refer to the residual marrow and the oil (grease) that was derived from bone boiling (Wheat 1972); as well as the introduction of a term for distinguishing other types of grease and fat on the buffalo carcass (Kidd 1937). Thus, our review of the ethnographic accounts was that bone processing for both marrow and grease extraction was undertaken by many groups, including Plains peoples, but that the details surrounding these activities were few and far between.

2) Archaeological Record

There are a number of archaeological reports which argue the presence of bone processing during both prehistoric (Vehik 1977; Delpech 1974; Dyck 1977; Frison 1978, Greiser et. al. 1983; Roll & Deaver 1978) and historic times (Hurlburt 1977; Pyszczyk 1978). These activities are usually identified on the basis of a requisite tool kit (Vehik 1977), intact archaeological features including fragmented bone and fire broken rock (Frison 1967, 1978) and a distinctive assemblage of bone elements (Pyszczyk 1978). The primary archaeological evidence of bone processing is the presence of abundant, nonburned bone fragments thought to be the discarded residue from marrow and grease extraction (Dyck 1977; Losey 1972). Vehik (1977) has argued that only the composite patterning of bone residue in association with requisite processing tools and associated features can be taken as evidence for bone processing (Vehik 1977:180). The flaws in Vehik's argument reside in the fact that tools used in bone processing are also commonly used for other tasks; boiling pit features can be used for cooking as well as bone rendering. The only unique aspect to bone processing activities is presumed to be the nature of the bone fragmentation, and to a lesser extent, the bone elements recovered. Unfortunately, there appears to be no concensus among archaeologists as to what kinds of fragmentation should qualify for bone processing, except that they should be 'small' and nonburnt. There appears to be general agreement that long bones are the preferred elements for both marrow and grease extraction (Binford 1978; Zierhut 1967); that mid-shaft fragments of long bones are probably indicative of marrow removal; and that the absence of articular ends in the assemblage can be taken as evidence of grease processing, 'all other things being equal' (Binford 1978).

Quantification of bone fragments has been attempted by several authors and each identifies slightly different parameters for the presence of specific bone reduction activities (Table 9), that is when a size class was specified at all. It was apparent that most archaeologists recognized bone processing intuitively, with minimal quantification of bone condition or size, and with minimal attention to documenting that the assemblage could not have been produced by other means.

The analysis of the HSI sample proceeded at two levels. First, it was necessary to establish a methodology which would include a quantification technique. The ethnohistoric sources and ethnoarchaeological studies are not sufficiently detailed to assist in the quantification of bone processing residues. The details that are provided (cf. Binford 1978) do suggest some general guiding principles, but the analogies are tenuous at best given the context of these studies and the unknown circumstances of a prehistoric plains camp and processing

Table 9

Comparative evidence for bone processing in an archaeological context. Bone fragment size in cms.

Reference	Minimum Fragment Size considered	Bone Marrow extraction	Bone Grease extraction
Binford (1978)	0.1	Impact chips 0.1-1.3	Pulverized bone piles
Delpech (1974)	1.0	4.0 Diaphysis frags.	Frags 2.0
Vehik (1977)	N/S	N/A	2.0
Quigg (Pers. Comm.)	0.6	6.0	3.0
Hurlburt 1977	N/S	1.0	1.0
Dyck (1977)	N/S	N/C	5.0
Pyszczyk (1978)	0.6	N/S	N/S
Frison (1978)	N/S	N/C	small fragments
Greiser et al (1983)	0.6	fragments	fragments
Losey (1972)	N/S	N/C	unidentifiable bone frags.
Roll & Deaver (1978)	0.3	bone fragments	bone
Noe-Nygaard (1977)	N/S	bone splinters	N/C

(N/S No specifics; N/C No comment)

area. It is important that replicative studies be conducted using Bison elements in the context of the Plains setting and according to the most reliable ethnographic data so that some parameters can be established for bone processing activities. Such experimental programmes are now being designed for the HSI research program and will be initiated in 1984. These studies will attempt to document the entire process of bone breakage, rendering of bone grease in boiling pits and observations on the kinds of fragments that result. As taphonomic agencies are felt to have substantially altered the HSI assemblage, both the bone processing residues and complete bone element portions will be exposed on the prairie flats in the vicinity of HSI, and periodic observations made on the degradation of the bone materials.

In anticipation of these studies the fragmentary bone assemblage gathered from the camp and processing area was subjected to a detailed quantitative analysis. It was first necessary to design a methodology which could be used to objectively quantity bone fragment size, that could be completed rapidly, and was replicable by other analysts. Secondly, the presence/absence of specific bone elements was evaluated to determine the relative abundance of the traditionally favoured elements for marrow and grease extraction.

3) Quantifying Bone Fragments

Several studies have attempted the quantification of bone fragmentation (Table 10). A variety of size intervals have been utilized (Dyck 1977, Quigg 1982), but use of bone weights predominates (Hurlburt 1977; Pyszczyk 1978) with limited use of volume determinations (Binford 1978; Dyck 1977).

Table 10
Bone fragment classes

Reference	Size Classes in centimetres 1	2	3	4
Quigg (1982)	0-3	3-9	9-15	15
Dyck (1977)	0-.5	0.5-2.5	2.5-5.0	5-13

The results of the studies by Quigg (1982) and Dyck (1977) indicate that almost all of the archaeologically recovered fragments were represented in the smallest class interval (0-5 cm), and that the majority of these were actually less than 3 cm in maximum dimension. In order to determine the size classes present in the HSI faunal assemblage an experimental study was assembled that utilized nested soil sieves to sort the bone fragments into size class ranges. The measurement of each individual bone fragment was impractical in the case of the HSI sample which was made up of literally thousands of minute, nonburnt bone fragments. For example, in one 2 m square it is estimated that nearly 50,000 bone fragments weighing approximately 16 kg were recovered from the upper 20 cm of the deposit (see Figure 29).

The bone fragments were passed through stacked sieves consisting of mesh sizes 31.5 mm, 16.0 mm, 11.2 mm, 6.3 mm and 3.35 mm. Repeated experiments with the same bone sample indicated that a given sieve size consistently retained a similar number and size range of bone fragments (Figure 57). The size classes are not mutually exclusive, but despite the overlapping size ranges the classes do define useful subsets of the bone sample (Figure 58). It was hypothesized that the size of the bone was strongly correlated with its weight, and correlation coefficients calculated for the sample runs discussed above confirmed this. This suggests that the weight of bone fragments contained within a given sieve size is a reliable estimate of the number of bone fragments present. We thus have a methodology that provides a relatively rapid and simple index of bone fragment size and count for different samples of unidentifiable bone fragments.

It was noted earlier that bone fragments were abundant at HSI, and although some of these may have resulted from bone processing it was felt that other factors, notably taphonomic processes, have contributed to the fragmentation of the assemblage. The taphonomic reduction of bone is accomplished via a number of discrete agencies, many of which can be subsumed under the collective processes known as weathering. The weathering of bone is only possible when the assemblage is not rapidly buried, and the context of the HSI camp processing area provides an optimal set of circumstances towards this end. In contrast to the kill

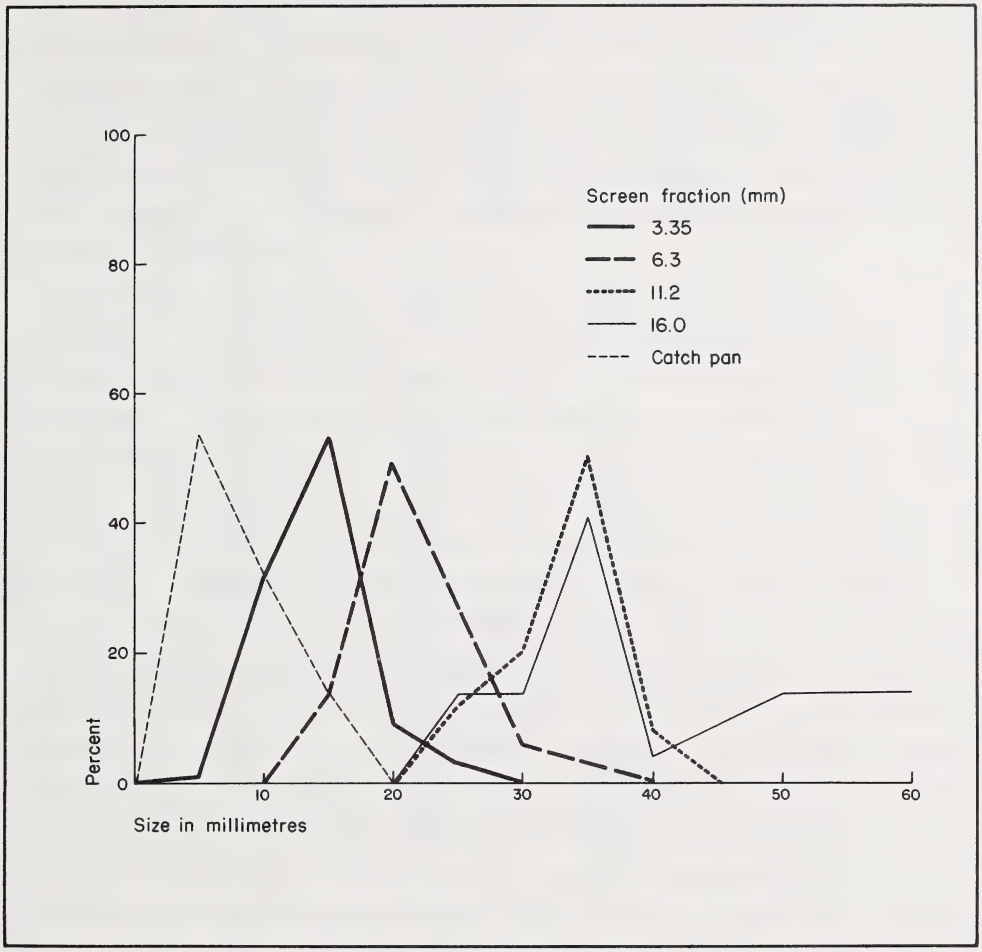

Figure 57: Results of sieve quantification of fragmented bone.

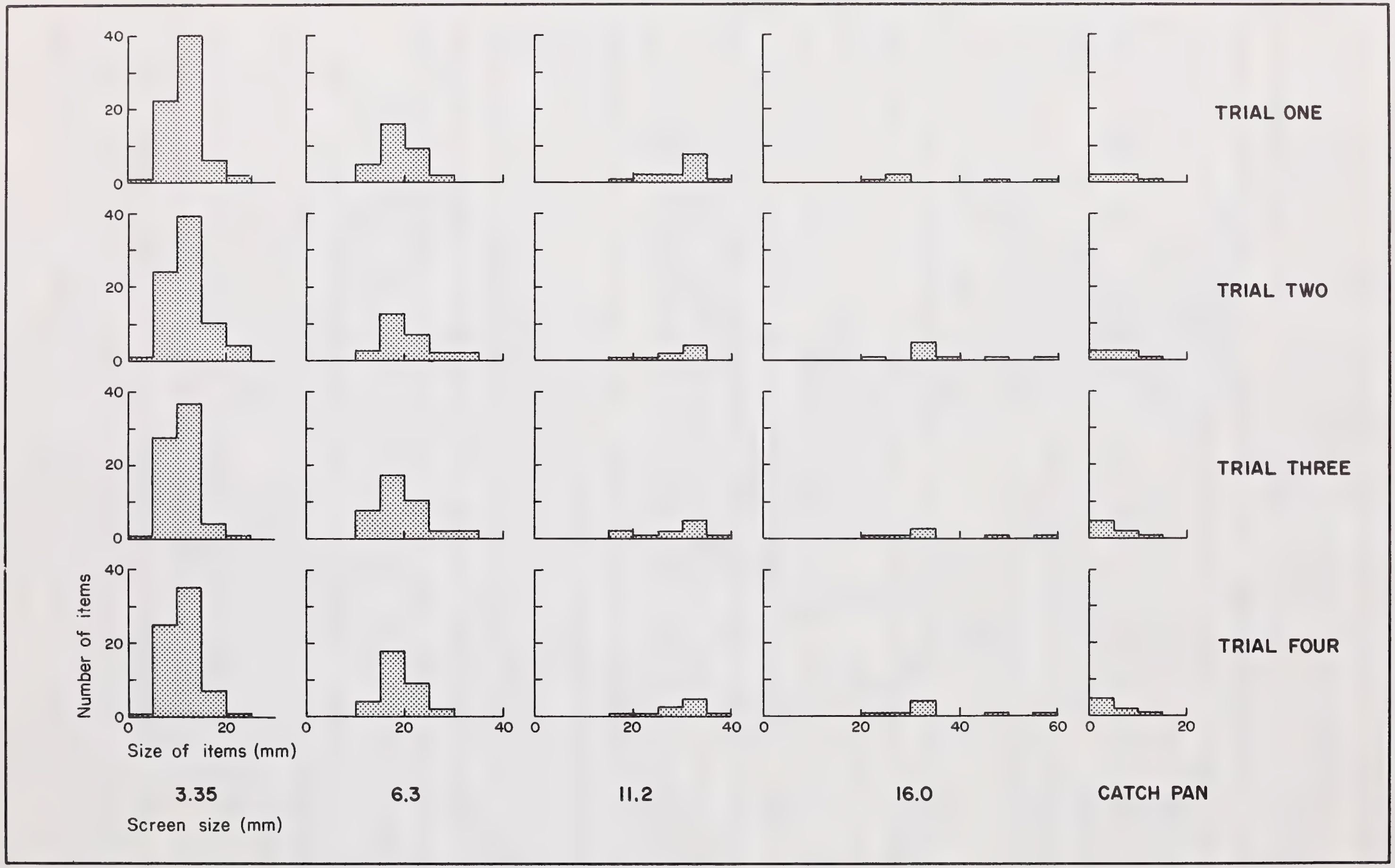

Figure 58: Size fractions of sieve quantification of fragmented bone sample.

site which is rapidly in-filled by sediments eroded from the cliff face, the camp processing area is a deflation surface providing no opportunity for quick burial. Bone deposits in the latter area can expect to remain exposed for many years, possibly many decades, and studies which have been conducted on bone weathering provide a number of indices for the identification of a weathered assemblage (Behrensmeyer 1978; Miller 1975; Tappen & Peske 1970).

The evidence of bone weathering is largely based on a qualitative assessment of bone condition, but the size and morphology of the bone fragments are also distinctive. The split line patterning that characterizes bone weathering (Tappen 1969; Behrensmeyer 1978) results in the production of bone splinters that tend to be rectanguloid in cross section and plan form; and causes exfolitation of the exterior bone surface. The proliferation of small bone splinters in conjunction with textbook examples of advanced weathering of bone elements from HSI clearly indicates a weathered assemblage (see Figure 55). This holds important implications for the identification of bone processing activities, for it is likely that weathering has reduced the number of specific bone elements which are most susceptible to weathering agencies (see Binford & Bertram 1977 for other attritional agents). For example, at HSI it was noted that limb bones dominated the assemblage, particularly the more robust carpals, tarsals, phalanges, and the articular portions of metapodials. The absence of other bone portions, such as articular ends of the long bones might then be assumed to be evidence of bone element processing (c.f. Greiser et. al. 1983; Roll & Deaver 1978). The possibility exists, however, that the missing elements and element portions did not survive to be recovered in the archaeological context. In this case the absence of specific bone elements, and bone element portions, at HSI may be the result of taphonomic reduction and not the preferential selection of elements for bone processing activities. It is interesting to examine the bone elements that are traditionally favoured in grease extraction activities, for it is evident that these are among the least dense bone elements (Binford 1978). It seems logical that the selection of bone elements for grease processing would be based on the relationship between two important factors; 1) the amount of grease present in individual bone elements; and 2) the relative ease or difficulty of altering the bones into a form which permits grease recovery. If these assumptions are true it would follow that preferential selection would be given to those bones which combine a large supply of grease with a low investment of energy needed to recover the grease. But taphonomic agencies would also be most pronounced on the less dense elements and it is therefore conjectural as to whether man or nature is determining the makeup of the archaeological assemblage.

The equivocal data provided by the presence/absence of particular bone elements in the HSI assemblage does not in itself assist in the identification of bone processing activities. In order to control for taphonomic reduction an assemblage of bone was sought that was not exposed to these attritional agencies. Fortunately the bone obtained from within the subsoil pit features at HSI provides such an assemblage, where it can be presumed that the fagmentation is wholly or primarily the result of cultural activities and not subaerial weathering or attrition. The fragmentary bone from the features was better preserved and of a larger size than bone from elsewhere on the site. To evaluate this size variability a sample of bone from the presumably weathered deposits of the camp/processing area was compared with that found with features. The comparison was designed to evaluate two things, first to objectively determine how the fragmentation differed between the two samples, and second to evaluate whether the fragments derived from the features were of a size class suggested by other authors to be indicative of bone grease processing. The methodology employed used nested soil sieves (as detailed earlier) to evaluate fragments size in the two samples.

The results of the sieve fraction test substantiated the observation that bone in the features is indeed larger; the size ranges are presented in Figure 59. The majority of the bone (based on numbers of fragments) falls in the smaller size classes (ie. 0.5 cm to 3.0 cm), which accords well with the results of previous studies (Quigg 1982; Dyck 1977). It is evident that small, unidentifiable bone fragments are not evenly distributed across the processing site, and that a much higher degree of fragmentation is evident in samples recovered from the general processing site area compared with samples from the pit features. If we assume that

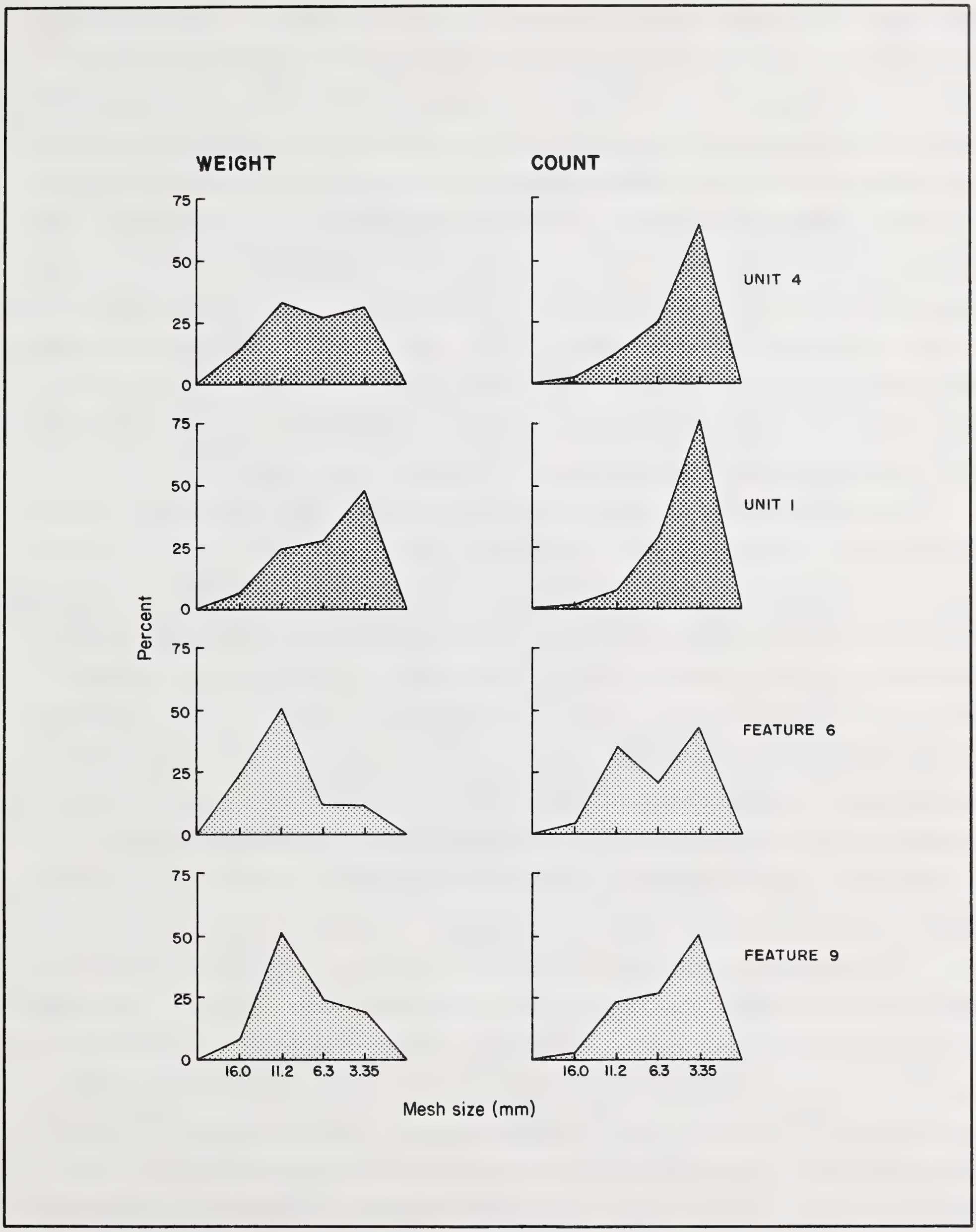

Figure 59: Bone fragment size in feature and non-feature contexts.

bone from all samples was subjected to similar cultural processes before abandonment, the greater fragmentation of bone from the non-feature context is argued to be a result of taphonomic agencies, including severe weathering from sun, wind, frost, and trampling by large ungulates and human hunters. The more rapidly buried bone in the pit features is, in contrast, shielded from many of these processes and may be argued to be a better representation of faunal material discarded after processing was completed. Obviously we assume that the bone recovered from the features is the by-product of some form of bison processing. However, in light of the ethnographic and ethnoarchaeological evidence of the production of bone grease we argue that the fragmented bone recovered from the features is inconsistent with the expected residue of this activity.

The conclusion of the experiments suggests that bone grease processing at HSI is not demonstrable on the basis of the bone fragmentation analysis presented herein, nor is it inferable on the basis of missing bone element portions. The argument for this specialized processing of bone remains must be supported on the basis of multiple lines of evidence and not simply assumed on the basis of the presence of highly fragmented bone. Most archaeological studies conducted to date which argue for bone processing at a particular site have failed to provide any detailed quantification of the bone assemblage being examined. It is important to realize that bone degreasing may not have been an automatic behavioural consequence of butchering animal remains. It is evident that the fats derived from bone grease processing are available in other substances present in the animal carcass, that grease content in bone varies with the season, that it may well have been obtained primarily in the fall season as a stored commodity for later consumption, and that it had a value not only because of nutritional factors but also as a commodity in trade and exchange (Wilson 1914; Flannery 1953). At the same time that the value of bone grease is recognized it is also evident that it is costly to obtain. With this in mind it is interesting to note that at least three bison kill sites, the Hudson-Meng, Frasca and Lubbock Lake sites, provided little or no evidence for bone marrow or grease processing (Agenbroad 1978; Johnson & Holliday 1980; Fulgham and Stanford 1982).

This raises the question of the utility or need for these processing activities when faced with a large supply of fresh carcasses. Despite an estimated MNI of 600 animals, Agenbroad (1978) reports virtually no evidence for bone breakage for marrow or grease processing at the Hudson-Meng site. Inasmuch as choices are made with respect to how an given animal will be butchered and to what extent some parts may be ignored (Speth 1983) there are also decisions to be made on the need to process bone remains. Bone grease extraction cannot be inferred based on the presence of fragmented bone and a requisite tool kit. The availability of processing materials, the type of occupation, the number of animals killed, the season of the year, the status of the labour force available are all important variables to be considered in forming an argument for bone degreasing. It is of particular importance that archaeologists pay attention to the quantitative and qualitative analysis of the bone fragments recovered so that the hallmarks of bone grease extraction can be discovered in a comparative framework.

Bone Tools

The last few years have seen an increasing amount of attention directed toward the study of bone technology by archaeologists (Frison 1974a, 1978; Binford 1981; LeMoine and MacEachern 1983). It is apparent that criteria for the identification of culturally modified bone vary from researcher to researcher and that detailed inspections of each item are requisite before identifying bone tools. The detailed visual examination is only feasible when the assemblage of bone is relatively well preserved and recovered in good context. Unfortunately little of the bone from the HSI site can be considered well preserved and in good context. The majority of the assemblage is heavily weathered and has been modified by several taphonomic processes including dessication, freeze/thaw, trampling and rodent gnawing.

The cumulative effect of these post depositional processes is that only bone items which are substantially modified, such as bone awls, can be identified with certainty as worked bone objects. There are some specimens that may be expedient butchering tools (catalogue numbers 22003, 4684). These two specimens (Figure 60), consist of a proximal

Figure 60: Bone chopping tools.

radius and a proximal tibia. Both the alterations that these bones and elements employed have been identified as tools in other contexts (Johnson 1982, Frison 1974a, 1982; Binford 1981). Given the preservation of the assemblage it is likely that many bone tools and tool fragments were not recognized. There are a number of fragmentary pieces exhibiting one or more ground and polished surfaces but the purpose for which these tools were employed is indeterminable. It is presumed that the majority of these tools fulfilled utilitarian tasks but some evidence of decorative bone objects was also recovered. The fifth metatarsal from a large canid recovered in Area 2 exhibits the characteristic groove and snap hallmarks of bone bead manufacture (catalogue number 5377 see Figure 61). The most numerous bone tool class recovered was bone awls, with a total of five specimens recovered. Only one awl is complete and is formed from a mammal long bone shaft splinter (Figure 61). The remaining awls were formed on mammal rib portions and none are complete. The form attributes of the fragments recovered suggests that while the distal portion of the awl was pointed, the proximal end of the tool was blunt and polished. The inference being that the tool fulfilled a number of functions beyond the task of piercing hide and other such materials.

Canids

The remains of 3 canids were found at Head-Smashed-In. Two of these canids were represented by skull and cervical vertebrae elements/fragments. These skeletal elements, particularly the mandibles, were suitable for descriptive and metric analysis to ascertain a species level classification and possible indicators of domestication.

Both specimens were found outside the main encampment area and kill site in an area considered a scavenger zone. This zone starts approximately 500 m south of the spring channel bisecting Area 2. Faunal material, features, and lithic debitage/tools are much more sparsely represented in this zone and we suspect that much of the scatter of bison material here is due to scavenger activity.

All canid material was found in the top 30 cm of the excavation units and is considered to belong to the late prehistoric period.

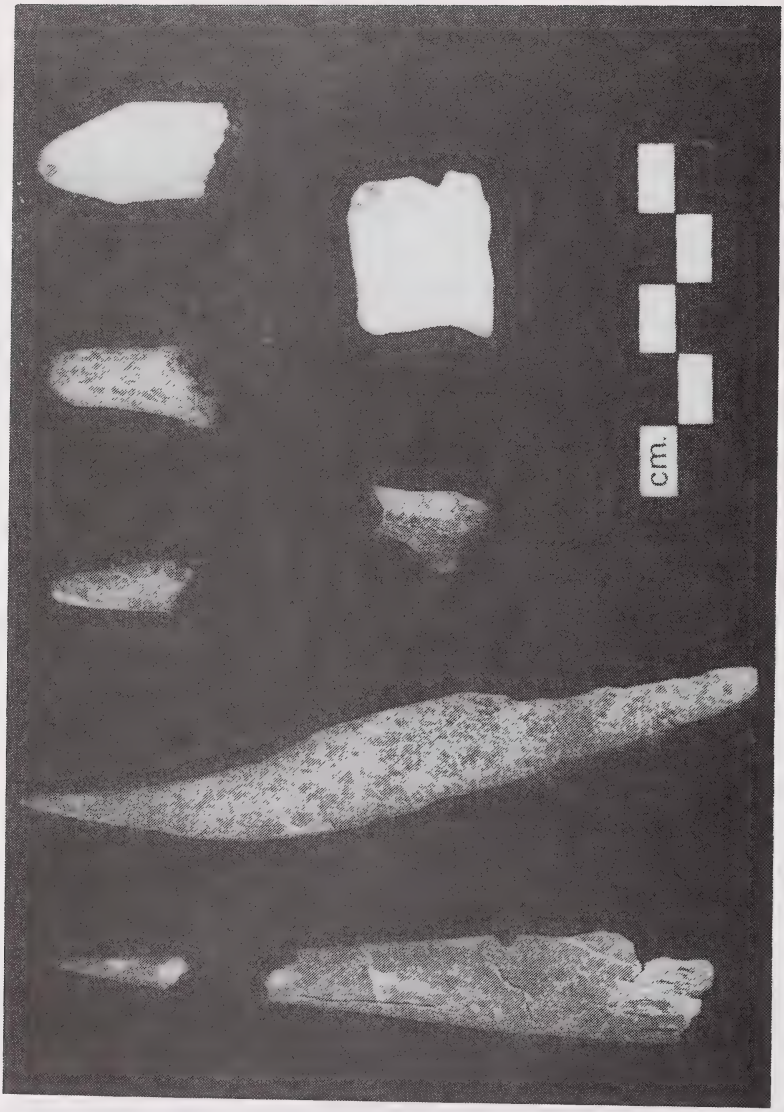

Figure 61: Bone and shell artifacts.

Large canids of southwestern Alberta could fall into four possible categories: 1) large dogs (Canis familiaris); 2) extra-large dogs as postulated by Driver (1976) (Canis familiaris); 3) wolves (Canis lupus) and; 4) wolf-dog hybrids.

The species classification was made on the basis of the lower teeth and mandibles. This classification was made through descriptive traits of relative robustness, muscle attachment area, cheek tooth spacing and overall size while metric ratios were used, where possible, to compare tooth size to horizontal ramus dimensions. These traits were selected to contrast the differences between wolves and dogs; the dog mandible being shorter, more robust with less muscle attachment area relative to the wolf. Dogs also have absolutely smaller teeth in which the premolars tend to crowd the first molar of the lower jaw. The metric traits used are from Driver (1976) and were chosen to emphasize the smaller teeth in the more robust mandible of the dog.

Each individual consists of a number of elements/fragments, as described below. Since each specimen is a 'composite' of many individually catalogued pieces they will be referred to as Specimen A and Specimen B. A complete description of each specimen can be found at the end of this discussion on canids.

Specimen A consists of a right mandible, left mandible, atlas, axis and third cervical vertebra. The right mandible was complete excepting the area forward of the P2 tooth socket. The P3, P4, M1 and M2 were retained in the mandible while the canine was recovered separately. The left mandible was missing portions of the anterior and posterior borders of the ascending ramus and showed a slight, post-mortem deterioration around the incisor alveolar region. This mandible contained the P3, P4, M1 and M2 teeth and its canine was also recovered separately. The vertebrae were complete. No skull portions were found.

These elements are thought to form a single individual because the minimum number of individuals count is one, all elements come from the same level, the wear on corresponding pairs of teeth from the left and right mandibles is nearly identical and the mandibles are very similar in size.

The left and right mandible can generally be described as mature, with all permanent dentition erupted and showing moderate wear. All teeth are worn to the point of dentine exposure on all cusps. The canines are an exception in that they show very heavy wear and have lost about 50% of their exposed (post-aveolar) height. This indicates that the canines were broken. Both canines also show a deep groove on the disto-lingual surface which means a prolonged contact with the upper I3's. Normal lower canine tooth contact is with the upper canines so this situation is a result of abnormally worn (ie. broken) upper canine teeth as well. The premolars of both sides tend to crowd the M1.

Specimen B is composed of a right mandible, left mandible fragments, skull fragments, the first three cervical vertebrae and the distal end of the right humerus. The left mandible was complete posterior to the canine but suffered excavation damage to the medial portion of the mandibular condyle. Retained in the bone were the P2, P3, P4, M1 and M2 and, again, the canine was recovered separately. The right mandible was represented by the alveolar region of the P4, M1 and M2 and contained these teeth. The skull remains were: the left maxilla and the P4, M1, M2 and M3 intact; the left and right frontals containing the upper regions of both eye sockets and; the complete basio-occipital and occipital region with fused portions of both squamosals and temporals present (Figure 62). Recovered separately was the left upper canine. The atlas and axis were complete.

These elements are also thought to belong to a single individual because the minimum number of individuals count is one, the size of the mandibles are very similar, the toothed maxilla portion occludes well with the corresponding section of the left mandible, the tooth wear patterns match and the amount of dental wear on all teeth is similar.

The left and right mandibles can be described as mature, with all permanent dentition erupted and displaying light tooth wear with slight dentine exposure on the higher cusps. Only the upper M1 shows complete dentine exposure on the linguial side, a typical situation in canids due to the nature of the upper M1 to lower M11 contact. The canines in this individual are unbroken. The premolars tend to be crowding the M1 when compared to the one male and one female Canis lupus specimens available for comparison.

The left mandibles of both specimens were compared to a female Canis lupus specimen in the Archaeological Survey of Alberta's comparative

Figure 62: Posterior portion of canid skull (Specimen B).

collection (Figure 63). The female wolf was selected for comparison because it was closest to the archaeological specimens in size and general morphology. Measurements were taken that would provide a general summary of the size of the mandibles. These measures are: 1) The tooth row length (from the most proximal point of the incisor alveolar region to the base of the anterior border of the ascending ramus); 2) The measurable tooth row length of Specimen B posterior to the canine to the base of the ascending ramus; 3) The width of the base of the ascending ramus (width of the most anterio-ventral to posterio-ventral points of the ascending ramus); 4) the functional height of the ascending ramus (length of the posterior border of the ascending ramus); 5) the maximum thickness of the horizontal ramus (as measured anterio-ventrally to the M1). Table 11 presents the comparison of three specimens.

Table 11

A comparison of the Head-Smashed-In Canids to a Female *Canis lupus*

Measure	*Canis lupus*	Specimen A	Specimen B
Tooth row length	134.23	112.65	----
Cheek teeth row length	110.60	87.46	102.01
Width of Ascending Ramus	42.16	41.18	41.91
Height of Ascending Ramus	44.60	29.88	30.79
Maximum Width of Horizontal Ramus	12.31	14.94	14.47

Discriminating characteristics from these general measures would lie in a more robust horizontal ramus and shorter ascending ramus for dogs relative to wolves. Since the archaeological specimens differ slightly in overall size from the comparative specimen, ratios were used to

Figure 63: Canid mandibles a) Canis lupus, b) Archaeological specimen A, c) Archaeological specimen B.

express robusticity and size. Cheek teeth row length was used to scale both the maximum width of the horizontal ramus and the height of the ascending ramus. These ratios are presented in Table 12.

Table 12

Ratios of: a) Maximum Width of Horizontal Ramus and b) Height of Ascending Ramus against Cheek Tooth Row Length for Head-Smashed-In Canids and Female Canis lupus.

Ratio	Canis lupus	Specimen A	Specimen B
a	.11	.17	.14
b	.40	.34	.30

The raw data in Table 11 and the ratios in Table 12 show that the archaeological specimens possess more robust horizontal ramii and shorter ascending ramii than the female wolf. It is interesting to note, however, that Specimen B has a more gracile horizontal ramus than Specimen A when size of the mandible is taken into account. Allometric scaling is probably a very minor factor in the small size difference between all specimens and would serve to increase the discrepancy between the wolf and archaeological specimens if allometry had any affect at all.

Other dog-like traits can be seen in the archaeological material, both have smaller masseteric fossae than the wolf, but these are deeper with well developed muscle markings. Specimens A and B also show a tendency for crowding of the M1 by all premolars.

Both archaeological specimens were measured by a method outlined by Driver (1976) to derive ratios which delineate wolf from dog on the basis of tooth length to mandibular robusticity; the wolf having larger teeth in a more gracile mandible. Such measures also allowed the Head-Smashed-In material to be compared with the sample Driver used. Driver's sample consists of 90 specimens of dogs, wolves, and coyotes (Canis latrans), including 17 dogs from archaeological sites in southwestern Alberta.

The following measures from Driver were applicable to at least some of the Head-Smashed-In material:

Measurement	Description
a	Latero-medial width of mandible ventral to M1
b	Crown length of M1
c	Latero-medial width of anterior base of ascending ramus
e	Minimum laterio-medial width taken at right angles to symphseal surface and posterior to canine
g	Alveolar length from anterior P1 to posterior border of M3
h	Alveolar length from anterior P1 to posterior border of P4

These measurements, for specimens A and B, are:

Measurement	Specimen A		Specimen B	
	Left	Right	Left	Right
a	14.9	14.4	14.6	--
b	24.4	24.9	26.6	26.8
c	12.6	12.5	13.0	--
e	14.5	13.7	15.5	--
g	--	--	92.4	--
h	--	--	47.9	--

These measures were then used to form the following ratios:

Ratio (Applicable to Specimen)	As a Measure of
a:b (A,B)	This assesses the relative thickness of the mandible when compared with M1 length. The ratio is lower for dogs due to smaller teeth in a more robust mandible.
b:c (A,B)	This is another expression of stoutness of mandible when compared to M1 size.
e:g (B)	This is a measure of tooth row length with stoutness of mandible. Ratio is lower for dogs due to a thicker mandible for the same length tooth row.
e:h (B)	This ratio expresses the thickness of mandible compared with premolar tooth row length. Ratio is lower for dogs due to a thicker mandible for the same length premolar tooth row.
g:a (B)	This ratio shows length of tooth row when compared with another measure of mandibular thickness. This ratio is also lower for dogs.

Driver's paper gives the alternatives of plotting the measures on graphs containing his classified samples or computing the ratios and comparing them to a table of ratios given for known comparative specimens and extrapolated archaeological specimens. The Head-Smashed-In specimens were plotted on the graphs as this gave an easier form of comparison to Driver's sample (Figure 64).

Specimen A's measures showed it to be a large (cf, extra-large) dog (Canis familiaris). Specimen B consistently fell in an area populated by smaller wolves and one 'extra-large' dog. Since the picture was still somewhat clouded for this last specimen, the basio-occipital/parietal/occipital fragment was examined for further clues to this last specimen's heritage. When compared to the comparible area of the female wolf's skull it could be seen that specimen B was slightly smaller but all areas for muscle attachment were much larger than in the female Canis lupus. Alternatively, when Specimen B was compared to the male wolf skull, the sagital cresting and nuccal markings were of similar size to the male but the actually calvarium was much smaller. The basio-occipital area was also more constricted than in either of the Canis lupus specimens.

As a result of this examination of the Head-Smashed-In material it is plausable that Specimen A is a large example of Canis familiaris. Specimen B would best be classified as a wolf-dog hybrid on the basis of a mixture of dog and wolf characteristics. Driver (1976) has made a case for including individuals displaying wolf sized teeth in a dog form mandible in Canis familiaris as extra-large dogs. He does so under the assumption that there was no mixing of wolf and dog heredity lines and has little alternative but to declare an extra-large dog when these wolf-dog hybrids are encountered.

Cases for domestication have been made on the basis of broken canines and a crowding of the premolars as an adaptation to diet in a campsite ecotone (Driver 1976). On this basis it could be stated that the Canis familiaris was the domesticate but no such assumption should be made about the wolf-dog hybrid.

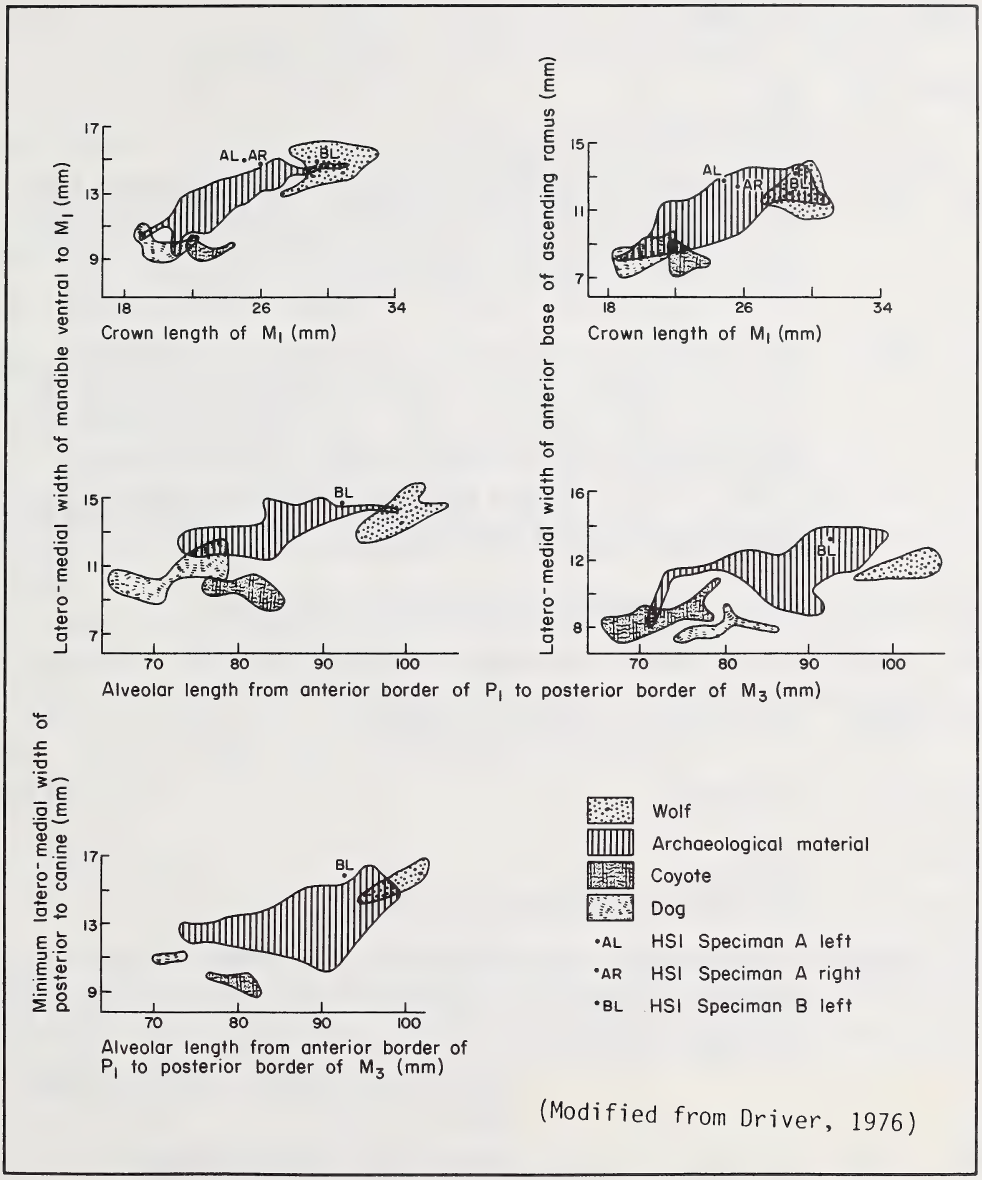

Figure 64: Discriminating mandibular dimensions of HSI specimens plotted against samples of wolves, coyotes, dogs and archaeological canid material from southwestern Alberta.

Description of Specimen A

Provenience: Area 12
Shovel Test 36
45 cm. DBS

Cat. #4202: Right mandible, complete excepting horizontal ramus forward of P2. Mandible contains P4, P4, M1 and M2. the mandible shows almost complete resorption of the M3 alveolus while the P2 tooth socket is approximately 75% resorbed. The canine was recovered but all incisors are missing.

Cat. #4203: Left mandible (reconstruction of 4 pieces), complete excepting middle third of anterior border of the vertical ramus and upper eighth of posterior border. The mandible contains the P3, P4, M1 and M2. The M3 was lost post-mortem but the P1 and P2 appear to be congenitally absent. The canine was recovered separately but all incisors are missing. The incisor alveolar region has been damaged post-mortem and is indistinct.

Cat. #4204: Atlas, complete (reconstruction of 3 pieces)

Cat. #4206: Axis, complete (reconstruction of 2 pieces)

Cat. #4205: Third cervical vertebra, complete

Description of Specimen B

Provenience: Area 1
Unit 902-3
Level 3 (20-30 cm DBS)

Cat. #10254: Right mandible, complete excepting horizontal ramus anterior of posterior portion of canine tooth socket. The mandible includes P2, P3, P4, M1, M2. The canine was not recovered nor were the incisors of the P1 or M3. The P1 and M3 were lost post-mortem. The medial quarter of the mandibular condyle was also lost due to 'shovel trauma'

Cat. #10255: Left mandible fragment consisting of a middle portion of the alveolar region and including P4, M1 and M2.

Cat. #10280: Left mandible fragment consisting of complete mandibular condyle.

Cat. #7493: Left maxilla and hard palate fragment containing P4, M2, M2 and M3.

Cat. #10260: Left maxilla fragment consisting of upper incisor alveolus and containing I1, I2 and I3. A small portion of the canine tooth socket is present.

Cat. #10256: Frontal fragments containing upper portion of eye sockets and post orbital construction. Also contained under this catalogue number are four frontal fragments containing sinus morphology.

Cat. #7492: Complete basio-occipital and occiptal region with fused portions of left and right squamosals and left and right temporals present. The bases of

Cat. #7494: Upper left canine

Cat. #10257: Atlas, complete

Cat. #10258: Axis, complete

Unidentified Remains

The majority of the faunal remains could not be assigned any taxonomic classification other than mammal. All fragments appeared to be from large animals. Large was defined as any animal bigger than a mature coyote.

Many of the fragments could be assigned to broad morphological categories. The tables presented below are divided into 3 element categories: long bone (Table 13), rib (Table 14) and vertebra (Table 15). Table 16 shows the distribution of unidentified large mammal fragments.

Other Species

Of the identified mammalian faunal material, 10.90% (154 of 1412) were not Bison or Canis. Of these 154 non-bison/non-canid elements, 147 are squirrel, pocket gopher or rabbit which bear no cultural assocation. Although it is possible that rabbit was used as a food item, the 135 identified rabbit elements represent two animals found as discrete concentrations. All of these specimens are thought to be intrusive and have no relation to the cultural interpretation of the Head-Smashed-In site. The areal provenience and NISP for these animals are presented in Table 6.

A left upper second premolar and a portion of a scapula probably represent one individual specimen of beaver (Castor canadensis) at H.S.I. This individual has no known cultural affiliation but may have been trapped. Alternately, it is known that beaver will scavange bone for its nutritional content.

Table 13

Areal Distribution of Unidentified Mammalian Long Bone Fragments
(in gms)

	Area 1	Area 2	Area 11	Area 12
Unit 1		102.0	13.0	39.2
Unit 2		196.7	10.2	
Unit 3			20.0	
Unit 4	5.1	9726.3	25.0	
Unit 5		88.4	592.0	
Unit 6		493.0	788.8	
Unit 7			91.5	
Unit 8			68.0	
Unit 9			391.0	
Unit 10			47.9	
Unit 11			6.3	
Unit 20				
Unit 21		1200.3		
TOTAL	5.1	11,806.7	2,053.7	39.2

TOTAL FOR SITE: 13,904.7

Table 14
Areal Distribution of Unidentified Mammalian Rib Fragments
(in gms)

	Area 2	Area 2	Area 11	Area 12
Unit 1				
Unit 2		8.4	23.8	23.2
Unit 3	41.3		9.3	
Unit 4		511.8		44.3
Unit 5			65.5	
Unit 6		493.0	59.1	
Unit 7				
Unit 8			6.1	
Unit 9			33.1	
Unit 10			11.2	
Unit 11			24.5	
Unit 20		124.0		
Unit 21		175.6		
TOTAL	41.3	1312.8	232.6	67.5

TOTAL FOR SITE: 1,654.2

Table 15

Areal Distribution of Unidentified Mammalian Vertebral Fragments (in grams)

	Area 1	Area 2	Area 11	Area 12
Unit 1				
Unit 2				7.9
Unit 3				6.6
Unit 4		137.4		
Unit 5		165.5	332.6	
Unit 6		38.3	43.6	
Unit 7				
Unit 8				
Unit 9				
Unit 10				
Unit 11				
Unit 20		74.8		
Unit 21				
TOTAL		416.0	376.2	14.5

TOTAL FOR SITE: 806.7

Table 16

Areal Distribution of Unidentified Mammalian Fragments
(in gms)

	Area 1	Area 2	Area 11	Area 12
Unit 1	401.7	4046.8	36.3	80.0
Unit 2	63.7	1269.1	36.0	99.0
Unit 3	329.9	200.0	44.7	72.1
Unit 4	155.5	12,123.76	47.3	332.3
Unit 5	61.1	224.0	578.5	
Unit 6	376.4	644.5	554.6	
Unit 7	59.4		47.2	
Unit 8	74.8			
Unit 9	469.6		221.2	
Unit 10	105.3		96.3	
Unit 11			85.3	
Unit 20				
Unit 21		1122.6		
TOTAL	2,097 9	19,630.7	1,747.4	583.4

TOTAL FOR SITE: 24,059.4

Three examples of mule deer (Odocoileus hemeonius) representing at least two individuals were recovered in 1983. Area 11 produced a second phalanx and a rib fragment from adjacent shovel tests. Area 12 produced a right upper third molar. Again neither specimen displayed any cultural alteration or affiliation and their deposition could have been a natural or cultural event.

Worked Shell

A total of seven pieces of shell were recovered in the course of the field investigations. Only two of the specimens revealed good evidence of having been culturally modified through one or more cut and ground margins (Figure 61). Neither is sufficiently complete to identify the species of shell fish employed but it seems likely that one represents a trade item for its size exceeds the morphological range of all indigenous species (Clarke 1981). It is well-documented that the Kootenay utilized the eastern foothills and adjacent plains on a seasonal basis (Turney-High 1941), and it is possible that they may have introduced such items having obtained these from coastal groups of the north west coast through interior trade networks. Presumably all the shell specimens were obtained for the purpose of manufacturing decorative objects but their use as a food source should not be discounted.

Summary

The emphasis of the faunal analysis of the 1983 Head-Smashed-In field season had two foci: understanding the cause of alteration in and destruction of the faunal material; and understanding the distribution of Bison elements both between the kill site and the camp/processing area and within the camp/processing area itself. Destruction of the bone is seen as a result of the physical cycles of heat and cold and wet and dry which bone is subjected to on or near the surface. Agents of disturbance probably result from very slow burial of the material due to an overall trend of deflation of the soils in the area. Slow burial fails to protect the assemblage form scavenging, trampling and overlay of other materials. Other active disturbing effects can be traced to soil slumpage from the cliff face and water erosion and transportation displayed by two spring channels within the site.

The faunal assemblage was representative of the extant fauna of the area. Identified large mammals were represented by Bison, Canids and Mule Deer. Not unexpectedly, the vast majority of identified remains were bison.

Density of bison bone is greatest near the main kill site area and decreases with distance to the south, east and north. Density is so great near the kill site that bone forms a veritable carpet with little chance to discern cultural patterns. This is due to prolonged usage of the site and soil deflation, which have prevented any stratigraphic markers or soil build up.

This distribution indicates HSI contains only one major kill site on the cliff but does not exclude the possibility of cursory kill zones within DkPj-1.

An analysis of the type of bison elements present in the prairie level excavation units shows this area to be utilized as a secondary processing area. A much higher proportion of elements associated with secondary butchering processes, that is elements which are found in portions of the carcass with a high food utility, are present in the prairie level part of the site. The predominance of secondary elements remains after the data has been adjusted to try to incorporate the variable of differential survivability of bison elements due to harsh taphonomic action on the assemblage.

Primary butchering, or the discarding of portions of the carcass with little food utility is presumed to take place at the kill zone.

The types of secondary food processing that took place at HSI were examined in some detail. Some methods of food processing such as drying, roasting and boiling meat must accompany butchering of mass quantities of animals if the meat is to last any length of time. Emphasis in analysis of the bison remains was placed on more esoteric forms of food production. Attempts were made to identify the bone byproducts of marrow extraction and bone degreasing. Some long bone elements displayed green bone breakage which is the only, but not conclusive evidence of marrow extraction. Bone degreasing, or the boiling of shattered long bones for their long lasting greases is thought to result in fragments averaging less than 5 cm in size. Samples of bone were examined representing fragments within features and fragments outside of features. Fragments within features were quickly buried and therefore relatively isolated from the types of taphonomic forces which were breaking down surficial fragments. The results of this examination showed that within features bone scraps were larger than surficial or shallow buried bone. This supported the hypothesis of their isolation from post-cultural breakage. However, these isolated fragments also proved to be too large to have resulted from bone boiling.

Other bison jumps also show intensive use of the site without having archaeological evidence of bone boiling (eg. Hudson-Meng, Lubbock Lake). It could be that the labour intensive processes of running a jump and meat preservation after a large kill do not allow time to gather the material resources or labour necessary for bone boiling.

An extensive literature search on the topic of bone boiling yielded no clear answer as to the material result of bone boiling. Experiments reproducing the ethnographic bone boiling procedure will be done in the 1984 field season to check our assumption of resulting bone fragment size.

Canid remains were investigated to ascertain a species classification and possibility of domestication. The 1983 excavations unearthed 21 canid fragments which were thought to represent three individuals. Two of these specimens were suitable for metric analysis of the mandible. The results indicated a dog and a wolf/dog hybrid were present in the assemblage. The wolf/dog hybrid could have been a domesticate, based on the presence of broken canines and heavily worn dental rows. An assumption of domestication would be based on ethnographic evidence that canine teeth were broken to prevent dogs from seriously harming the people and that heavy attrition of teeth was due to the harsh food domesticates were fed.

The remaining interesting category of animals in the assemblage was Mule Deer. These animals were represented by three elements and compose at least two individuals. No cultural alteration or affiliation could be seen however.

The remainder of the assemblage identified to species was small rodents. These remains have been categorized as intrusive and unrelated to cultural events at the jump.

The largest category of bone was unclassified material. It was estimated that at least 90% of all fragments/elements were unclassifiable as to species, and were classified as long bones, vertebra, ribs, or skull fragments of large mammals.

The 1984 research design for excavation at HSI calls for much more extensive recording and analysis of faunal information. With additional contextual information we hope to investigate the integrity of butchering units, seasonality and demography of the bison hunted at HSI

CERAMICS

All previous excavations within the camp/processing area of the HSI site have yielded ceramic remains. Boyd Wettlaufer (1949) recorded several sherds including cord wrapped stick impressed rimsherds, fabric impressed rim and body sherds and many small unanalysable sherd fragments. During the 1965 field season a number of 5' and 10' square units were excavated in the camp/processing locality totalling 800'^{2} (87 m^2) in area. The ceramics recovered from these units have been analysed by Byrne (1973:100, 300) and included 15 rimsherds, 4 necksherds and 6 body sherds. The decorative motifs and techniques recognized in the 1965 assemblage indicated ceramic variants of Saskatchewan Basin Ceramic Complex and the Cluny Complex and spanning a time range of nearly 2000 years (Byrne 1973:341). Both authors made note of the fact that the pottery was poorly preserved and highly friable which is not uncommon for most ceramic remains recovered from plains campsites. It is not surprising then that of the 110 ceramic items recovered during the course of the 1983 test evaluations only seven are sufficiently complete to warrant analysis. The seven sherds are rimsherd portions and represent the remains of three individual vessels.

The best preserved pottery was recovered from the excavations in the spring channel area (see Appendix 1, Figures 77-79) at the depth of 20 cm below surface. The external surface of the rimsherd is decorated with a corded impression which has been partially smoothed over and is consistent with Byrne's Truncated Cordmarked class, rim profile F (see Byrne 1973:677, Figure 12). The rim lip is slightly splayed and while the interior surface is plain the interior rim lip is impressed with cord wrapped stick decoration. There is a heavy deposit of carbonaceous material on the exterior surface of the sherd, indicating prolonged exposure to a high heat environment. A small cordmarked bodysherd was recovered in the level immediately below that of the rimsherd but it is not possible to confirm if a single vessel is represented by these finds.

The excavation of Unit 2 in the camp/processing area (Area 2) yielded an impressive number of ceramic remains but regrettably very few of these were of sufficient size to warrant attribute analysis. While there are likely to have been several vessels represented in this collection the available rimsherd portions identify only one vessel, and this was distributed over three contigious one metre squares. The rim is insloping but too fragmentary to determine the rim profile variety. The exterior surface of the sherd is decorated with rows of horizontal dentate stamping spaced at 5 mm apart. The lip of the rimsherd is decorated with parallel oblique rows of dentate stamping. The interior of the sherd is heavily encrusted with carbonaceous deposits and appears to be undecorated. The interior lip edge of the rimsherd is decorated with faint vertical notches. Microscopic analysis (40x) of the interior rim deposits failed to reveal any identifiable residues from the cooking of plant or animal foods but it was evident that the deposit was infused with sand and silt size particles. Such evidence provides mute testimony to the incessant sediment laden winds that characterize the area and that make simple excavation a constant battle.

The remaining identifiable rimsherd is a small portion of a truncated cord marked vessel from Area 2, Unit 4. The rim profile reveals a slightly splayed lip while the interior and lip surfaces are undecorated. All quadrants within unit four produced some ceramic remains but the degree of fragmentation renders vessel counts impossible. A necksherd from this unit reveals a truncated cordmarked exterior with a 7 mm diameter external punctate, but it is unlikely to be associated with the previous rim portion thus allowing a minimum vessel count of two.

The remaining ceramic assemblage is composed of non-identifiable fragments averaging less than 2 gr in weight. All of the units in Area 2 contained pottery except for Unit 5. Area 1, on the other hand, produced only seven sherd fragments inspite of the extensive sampling conducted in this area. This adds further support to the proposition that Area 1 was largely peripheral to the main camp and processing loci directly below the kill site and was not intensively inhabited.

The absence of a local clay source (at least as far as our observations indicate), suggests that the pottery was made elsewhere, probably at the main camp which may have been situated in the Oldman river valley. Future studies of the HSI ceramics will be directed toward determining the potential affinities of ceramic samples for the camp and the known sites in the river valley. In this way it will be possible to more closely address the issue of seasonal rounds and settlement patterning associated with the use of the HSI Buffalo Jump site.

FEATURES

Several features had been recorded in the HSI camp/processing area prior to the 1983 field investigations. These included hearths, ash-filled pits, concentrations of bone and FBR, and large pits filled with FBR and bone presumed to have been boiling pits (Reeves 1966 field notes). Unfortunately, more detailed notes of the features kept by R. Getty have not yet been located. Other plains sites have yielded similar feature assemblages (Brumley 1978, Dyck 1977, Quigg 1974, Frison 1978), and these are thought to have played an important role both in the processing of bison food products and the day to day maintenance of the family group. Typically at HSI the remains found within features are better preserved than those recovered from the deflation deposits that predominate in the camp and processing area. In addition, the contents of features retain a contextual integrity that is not found in the other camp and processing deposits and provide the opportunity of observing discrete events in time. Features, by virtue of their distribution within the site area, provide information on the kinds of activities being undertaken but also allow the discussion of how those activities were arranged in a horizontal perspective. Unfortunately the sample of features available from HSI is small and derived from widely spaced excavation units. Thus, while feature data can contribute substantially to the study of community patterning and reconstruction of bison processing activities, the more provocative questions that might be broached will have to await an improved feature sample. The purpose of this discussion is to provide basic descriptive details of the 1983 HSI feature assemblage, and to compare the sample with other plains feature assemblages and ethnographic observations of pit features.

Features are the non-portable artifacts of an archaeological assemblage and can be categorized under a number of headings. The initial dichotomy involves the recognition of those features that represent single events (synchronic), as opposed to those features that accumulate over time (diachronic). For example, the excavation and use of a subsoil pit feature represents a discrete event, whereas the formation of a midden deposit or living floor deposit is a cumulative process. The latter type of feature is particularly difficult to recognize at HSI given the deflation deposits that characterize much of the camp and processing area. The compression of several thousand years of occupation debris into a dense 20 cm thick cultural horizon effectively homogenizes the cumulative features into an undifferentiated mosaic of bone, FBR and loess deposits.

The single event features can be subdivided into architectural and non-architectural remains, both of which are present in the camp and processing area. Although no tipi ring structures were excavated in 1983, several complete and partial rings were recorded. It is notable that the only examples of architectural features are located in the more peripheral areas of the camp area, none were located in the "core" area below the main kill. This suggests that these structures were not present in the core area of the camp, or that successive disturbance through repeated occupations has destroyed all architectural features in the core area. In the absence of specific factors that would preclude the occupation of the core processing area, it appears most likely that disturbance occasioned by re-occupation has destroyed most architectural features at H.S.I.

The non-architectural features are conventionally subdivided into functional classifications based upon morphology and contents. The functional classes commonly recognized in plains camp sites include the ubiquitous hearth area, varieties of cooking features including baking, roasting and boiling pits, and specialized pits for bone processing, pottery production, hide smoking, and storage. At HSI it is presumed that the majority of the activities and some of the features were geared toward the task of processing the vast quantities of bison meat and bison by-products that resulted from the successful operation of the jump. The features recorded during the 1983 field investigations are summarized in Table 16 and are discussed in detail below.

Hearths

A total of four hearth features were recorded at HSI, but only one of these can be classified as a preprared hearth. Unprepared hearths are characterized by subsurface oxidized sediments that are created through the transfer of heat from a surface fire causing an oxidization of iron particles in the soil. Reddish stained soil is diagnostic of this oxidization process. Prepared hearths imply more than simply building a fire on the surface of the prairie, and can involve the use of rock linings, or ring rocks in association with an excavated basin in which the fuel is placed. The reasons for the two varieties of hearth are not well understood but likely results from the availability of preferred fuels (Wilson 1914:268), the season of the year (Dyck 1977), the type of campsite, and most importantly the specific purpose for which the hearth was constructed (ie. hearth, cooking, light: c.f. Guernsey 1984).

The single prepared hearth was recorded in the development area and is circular in form measuring 40 cm in diameter and 20 cm in depth. In profile the hearth revealed an upper lense of organic rich matrix immediately below the Ah horizon and overlying a shallow basin deposit of oxidized sediments contained burned and unburned bone, ash, charcoal, lithics and FBR (Figure 65). There was no apparent structure to the FBR distribution and no comment is possible on rock linings or ring rocks that may have been associated with this feature. A lanceolate point base was recovered from the hearth matrix but a radiocarbon assay on bone collagen recorded a modern date (Beta 7791). None of the bone recovered from the feature was identifiable below the level of class (ie. mammal), consisting of small calcined and non burnt portions. The use of hearths for roasting marrow bones is documented (Munson 1984:64-65) but the evidence for such activities is not preserved at HSI. The small amount

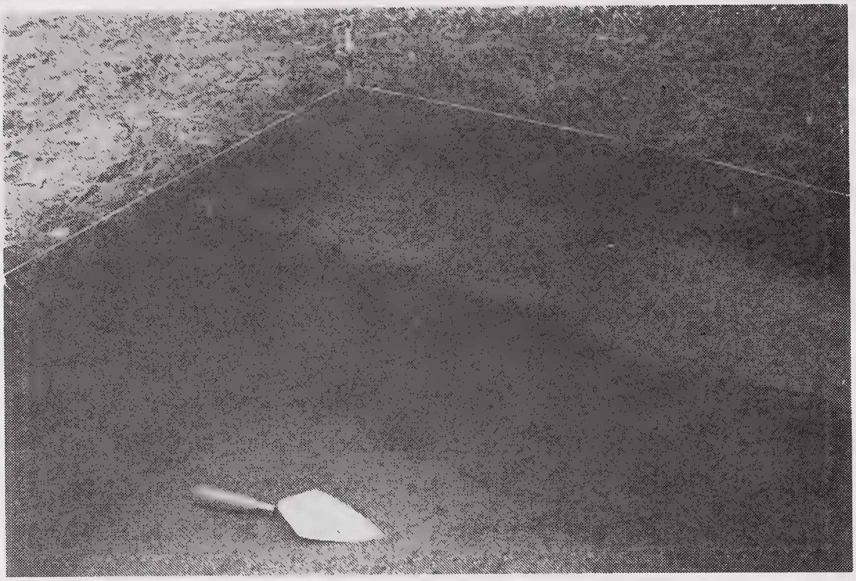

Figure 65: Prepared hearth, Unit 8, Area 1.

Figure 66: Backhoe trenching in slope deposits, Area 1.

of FBR recovered from the feature is inadequate evidence for roasting activities which typically involves both slabs of sandstone and concentrations of heated crystaline rocks used to maintain roasting temperatures (Frison et al. 1978, Frison 1973, Byrne 1973).
Unprepared hearths were recorded in both the development area and research areas. The single unprepared hearth from the development area was recovered during the course of backhoe test trenching operations of the upper slope near the building site (see Figures 11 and 66). Unfortunately the plan shape of the feature could not be directly observed but the distribution of bone and FBR in the trench allows a reconstruction of the feature form. The hearth is thought to measure approximately 30 cm in diameter and is roughly circular in form. The profile of the hearth was preserved in the backhoe trench wall and revealed a shallow dish shaped lense of oxidized sediments at 50 cm below surface (Figure 67). It is notable that this hearth is the only concrete evidence for cultural activity in the sloped areas of the development zone. The hearth matrix contained several canid bones, as well as bison element portions and revealed several pieces of FBR in association with some ash and charcoal. There was insufficient intact deposits from the hearth to allow collection of dateable materials. This hearth is thought to represent a single episode of food preparation that was for some reason conducted away from the main camp and processing flats. No cultural remains were recovered that would assist in dating this event, but the relatively shallow burial and rapid sediment accumulation in this area of slope wash suggests a late prehistoric time period.

Two unprepared hearths were recorded in the research area, both within the confines of a single 2 x 2 m square (Area 2, unit 2). The hearths are characterized by oxidized sediments occurring immediately below the Ah horizon. Although the features overlap, the presence of dessication cracks in only one of the hearths clearly indicates that they are not contemporaneous. The hearths reveal oval and circular plan forms measuring 35 cm x 30 cm and 24 cm in diameter respectively. Both are shallow basins in profile and measure 10 cm and 4 cm in maximum depth respectively (Figure 68). Neither feature contained remains in association with the oxidized sediments, although FBR, bone, ceramics and lithics were recovered in the upper 10 cm that overlay the hearth

Figure 67: Profile of hearth in backhoe trench, Area 1.

Figure 68: Profile of overlapping hearths, Unit 2, Area 2.

features. None of the FBR recorded above the hearth stains could be construed as circular or platform rock alignments that are known to have been employed in seasonal camps when buffalo chips were employed as fuel (Dyck 1977). It is likely that these features are representative of the majority of hearths at HSI, which were single events of heating and or cooking fires that were dispersed throughout the camp processing area during each use of the jump. Indeed, in many instances it is likely that the short term application of such hearths would leave little or no archaeological evidence except for reddened soil. This is especially true given the surficial disturbance of fire broken rock concentrations via successive occupations and other hearth construction episodes. Subsequent to the excavations of these two features a deep soil profile in the west wall of the same unit revealed yet another hearth stain. The plan form of the hearth is indeterminate but the basin shaped profile reveals a maximum depth of 24 cm for the feature (see Figure 24). It is possible that the profile is merely the westward extension of one of the previously recorded hearth features, but the possibility of a third overlapping hearth area cannot be ruled out.

Pit Features

Plains groups are known to have conducted a number of cooking and processing activities that required the construction of subsoil pits. In some cases the natural depressions present on the ground surface could be used and an earth or rock berm employed to form an expedient container (Frison 1967, 1978). Ethnographic records document the use of a hide and corner stakes to construct a 'suspended' pit, whereby no subsurface excavation is required (Lowie 1954:25). The majority of pit facilities recognized archaeologically are excavated features and the form and size of these features varies markedly. A total of three excavated pit features were recorded in the camp and processing area, two of which were located in the development area. Morphological details of these features are summarized in Table 17, and discussed in detail below.

The pit feature from Unit 7 in the development area is oval in plan form and measures 68 cm by 38 cm. The long axis of the feature is oriented east/west and a profile of this axis reveals an asymmetric basin profile with a maximum depth of 45 cm. This asymmetric configuration may

Table 17: Feature Data At Head-Smashed-In (1983)

CATEGORY	DIMENSIONS (cm)				MODAL SHAPE		CONTENTS	FBR
	MAX	MIN	DEPTH (B.S.)	VOLUME ESTIMATE (litres)	PLAN	PROFILE		NO/WGT (kg)
Rock Conc.	40	40	20	--	Circle	Shallow Basin	FBR	52/10.5
Rock Conc.	30	20	15	--	Oval	Shallow Basin	FBR, bone, lithics	208/6.6
Hearth	40	40	30	--	Circle	Deep Basin	FBR, bone, ash, charcoal, oxidized sediment	90/3.8
Hearth	35	30	20	--	Oval	Shallow Basin	Oxidized sediment	---
Hearth	24	24	14	--	Circle	Shallow Basin	Oxidized sediment	---
Pit	100	80	50	400	Oval	Deep Basin	FBR, bone, charcoal, ceramic, wk bone	1643/17.4
Roasting Pit	68	38	35	90	Oval	Asymmetric Deep basin	FBR, bone, charcoal, oxidized sediment	26/0.5
Roasting Pit	80	45	30	100	Oval	Shallow Basin	FBR, bone, charcoal, ash, ceramic	288/13.6

be the result of the west facing seating position of the original excavator. A thick layer of charcoal lines the bottom of the feature (Figure 69), and returned a date of 1160±50 years B.P. (AECV-21C). A dark brown sediment constituted the bulk of the feature fill, within which were contained bison phalanges, a metapodial fragment and several pieces of FBR. One of the pieces of FBR, a large tabular piece of sandstone, may provide an important clue as to the function of this particular feature. Lowie (1954:25), Wissler (1910:25) and Turney-High (1937) describe a roasting pit facility which involves the kindling of a fire in a pit which is subsequently lined with foliage, the items to be cooked and a capping of soil with a fire kindled on top of the feature. These roasting pits could be of two varieties, dry and wet, with the wet variety employed in the steaming of tubers such as camas and bitterroot (Turney-High 1937:262-263). The incomplete cumbustion evidenced by the charcoal lense, in conjunction with the bone elements and FBR, may be indicative of a dry roasting pit that has subsequently infilled with surficial debris. The large tabular piece of sandstone recovered from this feature may have provided a concentrated source of heat to facilitate the roasting process.

The second pit feature was recorded in Unit 9, located a short distance to the east of the previous pit feature. This large oval pit measures 80 cm x 45 cm and possesses a shallow basin profile with a maximum depth of 30 cm. The long axis of the feature is oriented NE/SW (Figure 70) and revealed a dense concentration of FBR within a dark brown matrix. In profile the pit was composed of a basal layer of charcoal (Figure 71) but there was no evidence of localized oxidation as seen in the previous pit feature. A dense jumble of FBR, bone, ceramic and lithic fragments rested immediately atop the charcoal lense which yield a date of 1300±70 years B.P. (AECV-22C). The presence of a nearby area of fire reddened soils prompted the suggestion that this feature represented a stone boiling pit. This interpretation does not adequately account for the basal lense of charcoal which would not be expected in a boiling pit or stone roasting pit. The boiling pits recorded ethnographically typically consisted of a hide lined pit which was filled with water and heated rocks added to either cook meat portions or render broken bone for bone grease (Wissler 1910; Turney-High 1937). It is more likely that the

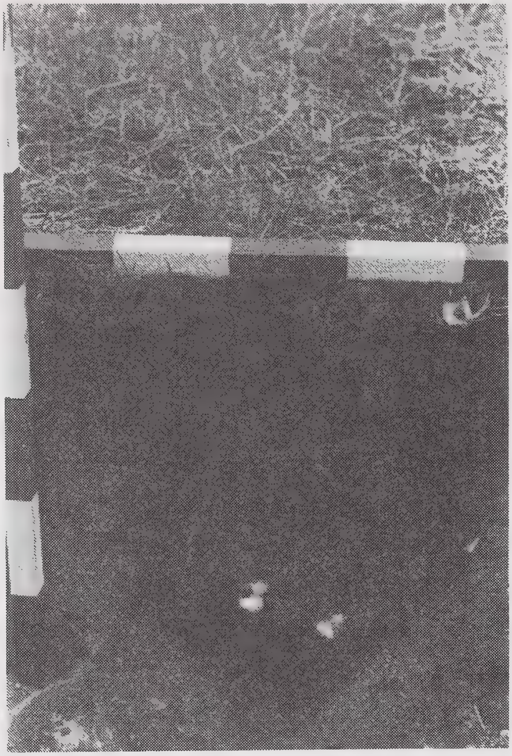

Figure 69: Pit feature, Unit 7, Area 11.

Figure 70: Pit feature, Unit 9, Area 11.

feature represents another variety of roasting pit which would have been composed of a layer of foliage overlain by heated stones, which in turn would have promoted the incomplete combustion of the foliage and resulted in the charcoal layer. Another possibility would involve the reuse of the above pit for purposes of stone boiling. This would involve the removal of the stone from the roasting episode, the lining of the pit with a hide and subsequent stone boiling activities. The hide might be abandoned *in situ* or removed for reuse, with the stone and bone residue slumping back into the pit feature in direct contact with the basal lense of charcoal. It is not surprising that pit features should be subject to reuse, for it is much easier to excavate an abandoned pit than to dig a new pit in the compact prairie soils. If, as we suspect, the HSI site was occupied for only a brief duration during each bison driving episode it makes sense to employ expedient means of pit construction. The hypothetical reuse of pit features is better demonstrated by the analysis of a third pit recorded in Unit 6/21 of Area 2.

This feature measures 100 cm x 80 cm and has a deep basin profile with a maximum depth of 50 cm (Figure 72). There are two distinct layers of feature fill; an upper 35 cm of dark matrix containing abundant bone and FBR, and a lower light coloured matrix 15 cm thick with few bone elements. This lower layer was extensively disturbed by rodent burrowing and some bone had been introduced into the lower matrix via these burrows. The most remarkable aspect of this feature was the condition and kinds of bison bone being recovered, including complete mandibles, ribs, vertebrae and horn cores. In addition, there were several small mammal bones, fish bones, clamshell fragments, worked bone, ceramics and lithic debitage. Given the layered aspect of the feature fill it was evident that two episodes of infilling had taken place and that therefore the pit had been used on at least two different occasions. The uses to which the pit may have been put are difficult to identify with certainty, for the present content of the feature is most likely to be redeposited, and may not reflect the original purpose for which the pit was constructed. The kinds of bone recovered from the feature represent a variety of elements that would not be expected to co-occur if the pit had been used for either bone processing or stone boiling (ie., horn core, mandible, thoracic vertebrae and lower limb bones). At the same time as

Figure 71: Pit feature profile, Unit 9, Area 11.

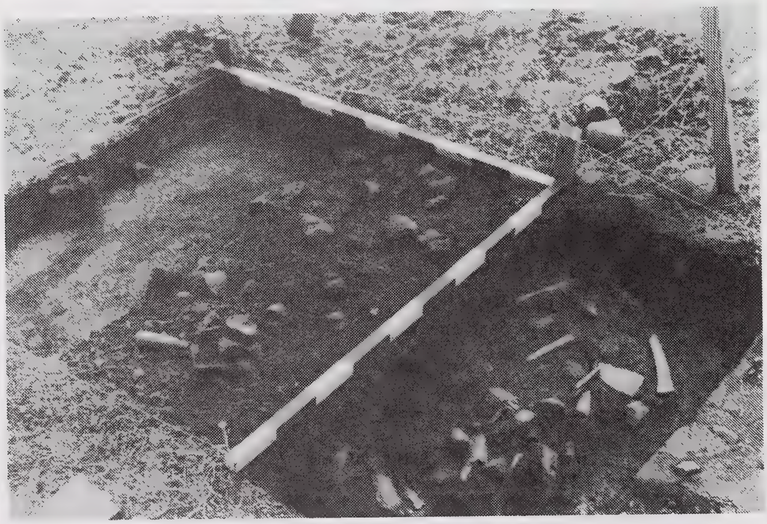

Figure 72: Pit feature, Unit 6/21, Area 2.

these elements are not likely to co-occur, they are largely complete which negates any argument for bone processing. What is most likely to have occurred in the instance of this large feature is the introduction of a variety of bison elements that were discarded in the immediate vicinity of the feature, and which subsequently fell into the abandoned and empty pit. Two episodes of infilling are identifiable. The first contained few bones and virtually no FBR, charcoal or organic rich sediments. Several of the bones recovered from this layer appear to have been introduced via a number of rodent burrows. This disturbance complicates the interpretation of this infilling episode, but the slope of the lower matrix appears to be consistent with the accumulation of wind blown sediments. The second episode of infilling is quite distinct from the first, consisting of large numbers of bone portions, including bison, small mammal and fish, and abundant FBR, charcoal, ash, lithics and ceramic fragments. There is a very distinct contact surface between the two layers which may have resulted from the partial excavation of the pit following the first infilling episode. The variety of remains present in the upper pit deposit are representative of the general debris that would be found throughout the camp and processing living surface. It is speculated that the upper portion of the feature matrix accumulated more rapidly than the lower portion, and that this took place while the camp and processing area was occupied rather than after abandonment.

The morphology and size of the pit can, in the absence of intact feature matrices, provide suggestions as to the pits original function. A volumetric estimate of 400 litres makes this the largest pit excavated to date of HSI. This is unlikely to have been a roasting pit as there are no intact charcoal layers or oxidized sediments evident. It is also unlikely to have been a storage pit, both because of the short term seasonal occupation of the site, and the resident rodent population which would rapidly infiltrate such caches. It appears more likely that this pit was a boiling facility, either for the purposes of cooking meat portions or rendering bone elements for grease. Similar large size pits have been interpreted elsewhere as boiling pits (Losey 1972) which would have been lined with an impermeable membrane, such as a green hide. Although the ethnographic record is replete with references noting the use of boiling pits on the plains few recorders documented the morphology or size of such facilities (Smith & Cole Will 1984, Verbicky-Todd 1984). The identification of the large feature in Area 2 as a boiling pit is therefore tentative; additional examples of pit features from HSI are anticipated and will assist in verifying such functional identifications.

FBR Concentrations

The most conspicuous feature at HSI is the dense pavement of firebroken rock and bone fragments that occur as a thick 10-20cm thick band over much of the camp and processing area (Figure 73). This deposit is interpreted to be the end product of many individual discrete activities involving hearth construction, stone boiling and meat roasting. As a result of successive re-occupations and recycling of FBR these discrete events become blended, and the deflation of these cultural deposits effectively homogenizes the cultural remains into a single pavement. These post depositional mechanisms appear to be more pronounced in the core of the camp and processing area, for several discrete concentrations of FBR have been recorded in the areas peripheral to core area. This is interpreted to be a consequence of the repeated occupation of the core area, as contrasted with the ephemeral use of the peripheral zones. Data supporting this interpretation are available in the distribution of FBR discussed in more detail elsewhere in the report. It suffices to state here that the FBR in the core area is abundant, but notably smaller in size than the FBR pieces recorded outside of the core area; presumably the result of curation and recycling of FBR supplies in the core area, as opposed to the primary discard of FBR in the peripheral zones.

Two FBR concentrations were recorded in the development area, and one was noted within the research area. All three consist of discrete piles of stone, two of which are not in association with hearths or pit features. Elsewhere (Munson 1984), such discrete clusters have been interpreted to be the residue of an above ground boiling facility, whereby a suspended hide is filled with liquid, boiling stones added and later abandoned. The decomposition of the hide would leave no surficial trace and the boiling stones would be left in a pile on the site surface. It is also possible that such concentrations could be the result of stockpiling FBR supplies in anticipation of future stone boiling activities or following the completion of stone boiling activities (cf. Binford 1978). We suspect this may be especially true of HSI where the preferred boiling stone material, quartzite, was not locally available.

The first FBR concentration in Area 1, unit 4 consisted of a 40 cm diameter stone pile, 20 cm deep (Figure 73). This feature contained 52 pieces of FBR weighing a total of 10.5 kg. There were no artifactual remains associated with the concentration but charcoal flecks and a single fragment of bison bone were found within and around the concentration. The presence of the charcoal flecks would be consistent with the short term stockpiling of FBR immediately following a stone boiling event with the charcoal adhering to the stone pieces.

The second FBR feature is also from the development area (Area 1, Unit 6) and consists of a small oval concentration of FBR measuring 30 x 20 cm with a concentric band of scattered FBR approximately 60 cm in diameter (Figure 74). The feature extended just beyond the first 10 cm level and was composed of 208 pieces of stone weighing 6.6 kg. There was a great deal of chipping detritus in association with the concentration and fragments of burned bone and charcoal recovered from elsewhere in the unit suggests that a hearth was located nearby. The association of this hearth with the FBR concentration is attractive but remains conjectural. Certainly the stockpiling of FBR supplies would be best placed in the immediate proximity of the hearth.

The final concentration of FBR was recorded in the research area (Area 2, Unit 3) and appears to be classifiable as a surficial stone heating facility. The FBR concentration measures 50 cm x 25 cm and is restricted to the initial 10 cm level of the test excavation (Figure 75). An oxidized zone of sediments was noted immediately under the rock concentration, and the feature was initially identified as a hearth. This interpretation was abandoned in light of the atypical arrangement of stone (ie. neither ringed or lined, but rather piled) and the lack of associated materials such as charcoal, ash and burnt bone. The interpretation favoured here is the stockpiling of FBR which could then be covered with fuel and the rock heated for stone boiling or stone roasting. Presumably this would have been done in association with a pit

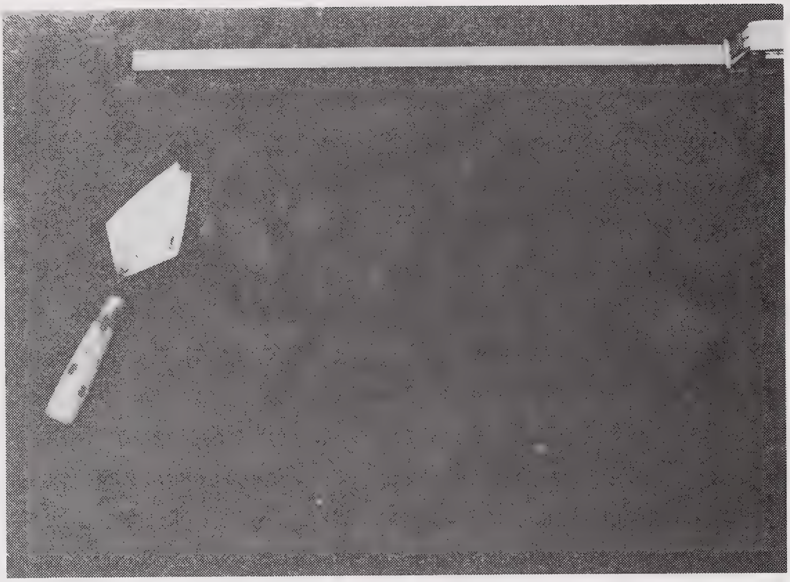

Figure 73: FBR feature, Unit 4, Area 1.

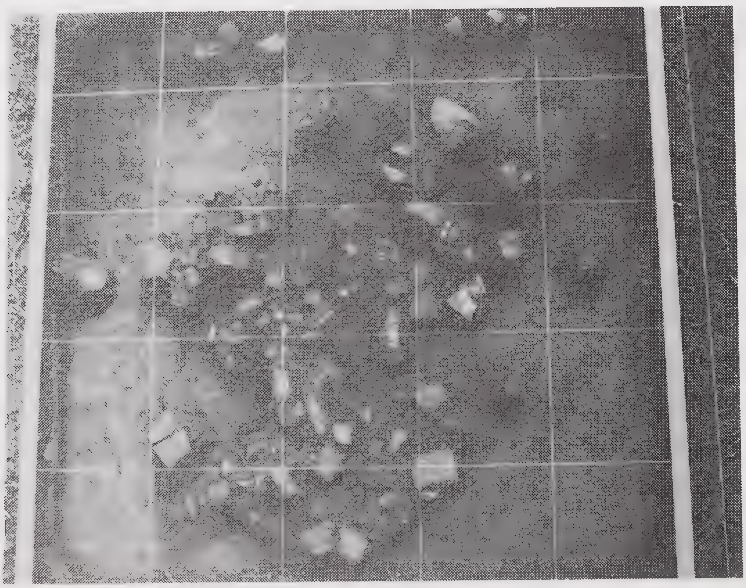

Figure 74: FBR feature, Unit 6, Area 1.

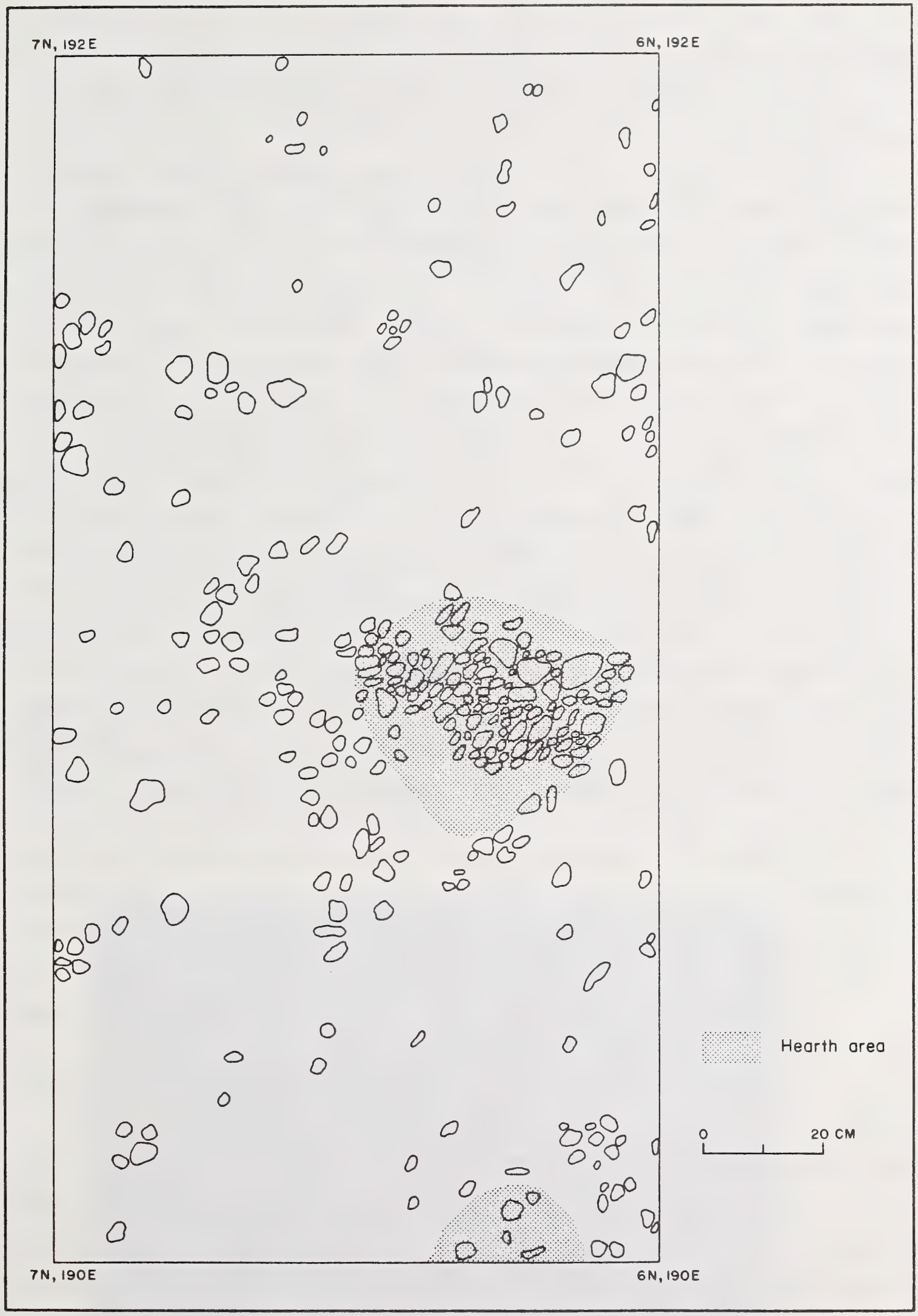

Figure 75: FBR concentration in north 1/2, Unit 3, Area 2, Level 1.

or other form of vessel, but none was noted in the test unit. The use of the concentration for food roasting would of course require no pit, and was the preferred means of cooking meat when employing bison dung as a fuel (Dyck 1977).

The last feature to be discussed before summarizing the feature data at HSI is what have been termed 'bone pegs' (Heitzmann 1983, Munson 1984). These are inferred to be portions of bone that were purposefully sharpened on one end and driven into the ground to provide tie off points for smoke hole controls inside of tipis, or for direct staking of the tent flap. Unfortunately there are a number of mechanisms that can reorient bone fragments following deposition, and the feature from HSI is interpreted to be the result of such mechanisms. Because much of the camp and processing area is literally overrun with ground squirrels there is and has been much burrowing activity at the site. The vertical chambers of these burrows provide a ready means whereby bone can be incorporated into an abandoned burrow and maintained in a vertical orientation by infilling of the burrow. The rib portion in Figure 76 has clearly been the result of such a process and provides a caveat for excavators when identifying bone pegs. This is not to imply that such staking devices do not exist at HSI but rather that such interpretations must be advanced only after careful examination of the feature context.

Figure 76: Rib portion in rodent burrow, Unit 1, Area 2.

Summary

The features recorded at the Head-Smashed-In Buffalo Jump provide an important adjunct to the compressed and rather intricate prehistoric record preserved in the shallow but dense deposits of FBR, bone and loessal sediments that made up much of the camp and processing area. Problems associated with the taphonomic reduction of the HSI bone sample has greatly complicated the interpretation of cultural bone processing activities. Features provide the opportunity for relatively rapid and deep burial of archaeological remains and preserve the more fragile hallmarks of cultural bone modification practises. Not only is preservation improved, but the contents of the feature represent a specific time period and activities that were conducted following the successful application of the jump. The ability of feature data to provide a glimpse of specific subsets of the cumulative activities conducted at HSI promises to provide important insights into how the camp and processing site functioned. It is interesting to note that most historic accounts dealing with Plains Indian bison exploitation stop short following the kill, and that the more mundane activities which consumed the majority of prehistoric peoples time and labour (ie. processing, redistributing, storage, manufacturing of bison by-products, and day to day camp maintenance activities) are currently not well understood. The features at HSI provide one of a very few sources of data that retain some contextual integrity, that reflect specific episodes of site useage, and that provide clues to the complex activities which prehistoric people engaged in to insure that the vast quantities of bison acquired as a result of the successful driving of a herd were adequately exploited.

DATING

Reeves (1978) has provided a number of radiocarbon dates for the kill site deposits at HSI. As far as we know, no dates have previously been obtained for the archaeological remains from the camp/processing area below the kill. Our 1983 excavations at H.S.I. demonstrated a compressed record of multiple occupations on the prairie level, making dating of these remains very difficult. While we wanted to obtain some dates for the events which have transpired on the prairie level, we also wanted to have these dates be of some interpretive value. As a result, radiocarbon samples were submitted primarily from excavated feature matrices or from stratified deposits near the steep slump blocks. A brief description of these samples is provided. All dates are uncorrected.

ASA-1 (Beta-7718)

This was a bone collagen date obtained from a portion of a single bison humerus weighing 735 gms. The humerus was recovered from excavations in the spring channel in Area 2 at a depth of 150-160 cm below surface. This represents the deepest level excavated in the spring channel. We encountered a massive layer of bison bone at this depth but were unable to complete excavation of the deposit prior to the end of the field season. A date on this sample was obtained in order to provide an estimate of the rate of deposition in the channel (see Appendix 1). The bone collagen produced a date of 1660±80 years before present.

ASA-2 (S-2500)

This is a bone collagen date obtained from a number of bison bone elements weighing 418 gms. The bones were recovered from 135 cm below surface in a backhoe trench excavated adjacent to units 8 and 9 in Area 11. The sample was dated so as to provide an estimate of the rate of deposition on the prairie below the cliff. Cultural material had been recovered in this area in the upper 20 cm of loess, but hand excavations below this level were sterile. The backhoe was sampling for deeply buried deposits when a number of apparently articulated lower limb elements of bison were encountered. No cultural material was associated with the bone, and the animals death may well have been natural. Nevertheless, the date of 7065±175 years before present on this bone does indicate that cultural evidence of earlier use of the site may be deeply buried and undisturbed in areas near the slump blocks.

ASA-3 (AECV-21C)

This is a charcoal date based on a sample collected from a pit feature in Unit 7, Area 11. A charcoal lens lined the bottom of this feature at a depth of 30-40 cm below surface. A date of 1160±50 years before present was returned from a sample of 22.47 gms of charcoal. The feature also contained bison bones, fire broken rock, and lithic artifacts, and was characterized by an oxidized sediment around the pit (Figure 69).

ASA-4 (AECV-22C)

This is a charcoal date obtained on a sample obtained from a pit feature in Unit 9, Area 11. The charcoal lined the bottom of the pit feature, which also contained lithics, fire broken rock, pottery fragments and shell (Figure 70). A sample of 15.96 gms was submitted and returned a date of 1300±70 years before present.

ASA-5 (AECV-23C)

This is a charcoal date obtained from the large pit feature excavated in Units 6 and 21 of Area 2. This feautre contained great quantities of bison bone, fire broken rock, lithics, and stained soils (Figure 72). A total of 12.1 gms of charcoal was submitted and returned a date of 1050±70 years before present.

ASA-6 (Beta-7791)

This is a bone collagen date obtained from 212.1 gms of bison bone collected from a hearth feature in Unit 8, Area 1. Bone, fire broken rock and lithics were associated with the hearth feature which extended from 5 to 20 cm below surface (Figure 67). The bone sample returned a modern date. We are unable to evaluate this modern date. The hearth matrix contgained a point base which typologically appears to be of considerable antiquity (Figure 42 b). The modern date may be the result of a recent hearth event conducted in historic times coincidently placed over some early artifactual materials. We regard this as unlikely due to the absence of any surficial evidence of recent activity. Unit 8 in Area 1 is located on very level ground well away from the cliff and slump deposits, where deposition is minimal and all cultural material is contained in the upper 10 cm. The lack of any surficial evidence of recent hearth utilization cause us to question the modern age estimate returned from this hearth feautre. We can only guess that some form of contamination of the sample has occurred.

ASA-7 (Beta-7792)

This is a bone collagen date obtained from bison bone collected from Unit 4 in Area 12. The bone was obtained from level 6 (50-60 cm) of our excavations in a proposed parking area. The bone was not contained in a feature, but rather was found in the stratified deposits on the sloping ground surface near the edge of the escarpment. The bone was dated so as to provide an idea of the rate of deposition and the periodicity of the slump and wash events which have presumably caused the stratified soil horizons. Little cultural material was associated with the bone. A sample of 583.74 gms yielded a date of 1620±80 years before present.

ASA-8 (Beta-7793)

This is a bone collagen date from bison bone recovered from Unit 6, Area 11. The bones were recovered from stratified soil deposits between 40-50 cm below surface, not from a feature. Cultural materials were scarce in excavation Unit 6 and adjacent units placed very close to the steep slope of the slump blocks. The date was obtained to assist in interpreting the depositional history of the area below the slump materials. A sample of 536.07 gms returned a date of 310±80 years before present.

ASA-9 (Beta-7794)

This is a bone collagen date on bison bone recovered from Unit 6, Area 11. The bones were collected in level 1 (0-10 cm) of Unit 6 in stratified soils directly above the bones which yielded the previous date of 310±80 B.P. (BETA 7793). The second bone sample from Unit 6 was dated so as to provide a bracket for depositional rates of the various paleosols evident in the excavation near the slump blocks. A sample of 230.43 gms returned a modern date. Given that the previous sample collected from 40-50 cm below surface returned a date of 310±80 B.P it is not surprising that bone from 0-10 cm in the same unit returned a modern date. We have no reason to question the modern date, and suspect that it applies to animals killed and butchered during the last aboriginal use of the area some 140 years ago - a time span too short for radiocarbon dating.

In summary, nine radiocarbon samples were submitted yielding two modern dates and seven dates which span a time from 310 to 7065 years before present. Six of the dates fall between the years 310 and 1660 B.P, with the single old date of 7065 being from unmodified bison bone recovered from 135 cm deep in a backhoe test. Five of the dates cluster tightly between the years 1050 and 1660 B.P. The fact that these dates come from a widespread area covering the core processing area (Area 2) and fairly distant peripheral regions (Areas 11 and 12), and that the submission of samples reflects no concious attempt on our part to date any specific time periods or cultural phases, suggests an intensity of site utilization during the first half of the Late Prehistoric Period. This is consistent with suggestions by Frison (1978) and Reher and Frison (1980) that the time period between 1500-500 years ago represented a period of optimal bison hunting on the Northwest Plains. The HSI dates are also consistent with the great bulk of the points recovered in 1983 which are typologically assignable to several Late Prehistoric types.

The date of 7065 B.P. is important in that it indicates the possibility that early use of HSI may be found in undisturbed deposits below and separated from the compressed archaeological record of the Late Prehistoric period. This reinforces the need to continue deep testing at the camp/processing area, and to monitor deep excavations associated with site development. This date is also important because it won Jack Brink a bottle of wine from Barney Reeves; a bottle yet to be delivered.

COLUMN SAMPLING

Following the completion of each excavation unit a column sample was removed from the south west corner of the unit. The column measured 50 cm square and was excavated to sterile deposits in 10 cm levels. The column samples were taken to evalute the recovery loss occasioned by the use of 1/4" (6.3 mm) screens. It became apparent during the excavations that a large number of small bone fragments and debitage were passing through the 1/4" mesh and evaluation of the column sample data helps to quantify this recovery bias. In addition, the columns provide information on the numbers of sandstone fragments present in each excavation area, an indication of the amount of colluviated materials in different areas of the site.

The column samples were processed using a flotation device described by designed by Watson (1976) which consists of a 45 gallon drum, an insert screen with 2 mm mesh, and an overflow spout to collect the float fraction. In the case of the column samples the float fraction was not retained and only the heavy fraction retained in the insert barrel was analysed. The samples were air dried and returned to the lab for sorting and evaluation of the various sample fractions (ie., lithic, flake, ceramic, bone, sandstone, soil peds and other). Because of the large volume of soil processed, and the density of material remains in each 10 cm level, several of the samples were split using a soil sample splitter into 1/2 and 1/4 fractions. This greatly shortened the sorting time required for each sample which was subsequently passed through nested Tyler soil sieves of 6.3, 3.35, 2.0 an 0.85 mm mesh size. This technique produced 5 mutually exclusive size categories of $>$6.3 mm, 6.3 - 3.35 mm, 3.35 - 2.0 mm, 2.0- 0.85 mm, and $<$0.85 mm. The five sample categories were visually sorted into the material classes noted earlier, with the exception of the 2.0 and 0.85 mm fractions. Owing to the large numbers of minute bone fragments and debitage the smaller fractions were not physically sorted, but the percentage by volume of each material class was estimated. Raw counts of the numbers of items, of each material class, proved impractical and only the weight of each material class was recorded.

The results of the column sorting were plotted on frequency curves and pie diagrams, and the samples were retained for subsequent evaluation. This discussion is limited to a qualitative summary of these detailed results.

Those units which were located in the proximity of the cliff slope were consistently observed to contain large numbers of sandstone fragments in all fractions. This is felt to be an indication of significant amounts of slope wash and may have introduced some cultural and non-cultural materials into the excavation units. In many instances the degree of slope would have motivated the avoidance of sloped areas for more level zones of the camp and processing site. The correlation of material remains with the more nearly level areas of the site was consistently high, and even a few degrees of slope would see a rapid drop in the numbers of cultural remains encountered. The presence of the large numbers of sandstone fragments appears to be another useful index of areas that may have been avoided as campsite locations, but may well have been utilized during some processing activities.

Bone fragments were recovered from all column samples and all sample fractions. The small size of the fragments made them unsuitable for purposes of faunal identification but they do assist in the recognition of past depositional modification of bone elements. Bone remains were not distributed evenly over the site area, and the preservation of elements was not consistent between excavation units. This is interpreted to be partly the result of taphonomic processes, primarily weathering and trampling. Those excavation units which produced the largest quantities of bone also yielded the largest concentrations of bone fragments in the column samples. This, in and of itself, is not particularly revealing, but the nature of the fragmentation is quite informative. Earlier in this paper the discussion of bone processing suggested that much of the bone fragmentation observed at HSI was probably not the result of cultural activity. The column sample data support this contention for bone fragments are found in all of the screen fractions including the less than 0.85 mm class. If the bone fragmentation was the result of cultural mechanisms it would be reasonable to expect a given size range of bone fragmentation, depending on the specific bone processing activities being undertaken (see earlier discussion). The size range of bone fragments recovered from the columns suggest that fragments and element portions are being further reduced following the abandonment of the site to a point where the fragments are less than 1 mm in maximum dimension. Such fragmentation is unprecidented in either ethnoarchaeological or ethnographic accounts of bone processing activities. Therefore while it is evident that 1/4" mesh did not retain all of the bone fragments the smaller pieces of bone seem to convey little cultural information. In fact much of the fragmented bone at HSI is of little cultural importance given the results of the analysis presented earlier, and subsequent field investigations will employ alternate methods for the recovery and analysis of bone fragments.

Lithic remains provided the initial impetus for collection of the column samples and are more suited to quantification of recovery loss than bone fragments. Comparisons of the excavated sample of debitage and that recovered from the column sample have only been completed for one excavation unit to date. The unit was located in the richest area of the camp and processing site and the results may not be comparable in other less intensively occupied areas. It was originally hypothesized that much of the lithic reduction conducted at H.S.I. was not primary reduction of cores or tool blanks, but was largely focussed on the maintenance of tools that were brought to the site. Elsewhere (Reher & Frison 1980) this has been characterized as "gearing up" for the use of the jump site. A total of 3165 pieces of lithic debitage were recovered from the initial 10 cm level of the 2 x 2 m unit. The corresponding level of the column sample produced 760 items of debitage and estimates that at least 91% of the debitage by count was not retained in the 1/4" (6.3 mm) mesh utilized during excavation (Hughes 1984:7). While this recovery bias may seem extreme, it is apparent from other studies of recovery bias (Fladmark 1982, Bobrowsky and Ball 1982) that values in the range of 99% and 96% by count are common. This does not necessarily compromise the results of the analysis of recovered debitage, but does indicate that a great deal of tool maintanance was being conducted at HSI. There was no bias in the recovery of the different material types employed at HSI, but it was noted that the more coarse grained materials were minimally represented in the smaller debitage classes compared to the finer grained materials (i.e., cherts, obsidian). Table 18 provides a breakdown of the lithic material types recovered from the column sample, and indicates the recovery bias in terms of percentage count of material missed using standard excavation recovery techniques (i.e., 1/4" mesh).

FIRE BROKEN ROCK

During the course of the 1983 field investigations at HSI fire broken rock was drawn <u>in situ</u>, counted and weighed. Inspection of the floor plan maps resulted in the identification of several concentrations which are discussed under the section dealing with features. These are,

Table 18
Column sample results, Unit 4, Area 2.

Material type	Screen Size (mm)				Total	% Recovery Loss
	6.3 mm	3.35	2.0	0.85		
Chert	28	8	408	44	488	94.3
Chalcedony	4	44	44	4	96	95.8
Quartzite	20	32	20	0	72	72.2
Obsidian	0	4	8	4	16	100.0
Petrified Wood	0	12	16	0	28	100.0
Silicified Siltstone	8	8	28	0	44	81.8
Sandstone	0	4	0	0	4	100.0
Argillite	0	0	4	0	4	100.0
Mudstone	8	0	0	0	8	--
TOTAL	68	112	528	52	760	91.0

however, the minority of the FBR remains, for most occur in the form of dense pavements that cover most of the camp and processing area, but do not reveal any obvious patterning. Despite the ubiguitous distribution of FBR over the site area it was evident that some areas produced greater numbers of FBR, and that there was qualitative variation in the size of FBR throughout the camp and processing area. The purpose of this section is to detail the latter variability, and to discuss some of the archaeological implications of such distributions. We also present some discussion of the material types employed as FBR at HSI. Although the locally abundant sandstone blocks were occasionally used, they are by far in the minority compared to the quartzite rock which is not locally available. The abundance of the imported materials, which are located some 2 kilometers east and south of the site, suggests that the local sandstone is either a poor quality boiling stone, or was used for specialized tasks only. Some discussion of an experimental program to evaluate the properties of the sandstone as opposed to quartzite is presented; more elaborate experiments will form part of the 1984 field investigations.

The excavation of the camp and processing site was divided into three areas and the analysis of FBR is presented below for the individual areas.

Table 19 presents a summary of FBR recovered from all excavation areas, and it is clear that the vast majority of FBR is derived from Area 2. The significance of this distributional anomally is only apparent when excavated area is considered, for with the exception of area 12, area two was the scene of the least amount of excavation. Therefore, the density of FBR in Area 2 is substantially higher than the other areas, with an average of 21.2 kilograms of FBR per cubic meter of excavated matrix. At the same time, however, the average weight of the FBR in Area 2 is substantially less than that recorded for Areas 1 and 11 (Table 19). The reasons for these anomolous distributions are felt to reside in a complex interplay of distance from the killsite, degree of slope, curation of FBR supplies, and repeated reuse of FBR closer to the main processing area.

The excavations in Area 2 are in close proximity to the jump site and it is natural to expect that this area would be repeatedly used and hence the greatest density of FBR could be expected to occur. At the same time as Area 2 is being reoccupied, the discarded FBR from previous occupations would be recycled. This results in a significant amount of small FBR fragments, which represent exhausted pieces of FBR that are literally too small to warrant re-heating. The more peripheral areas of the camp and processing site, such as Areas 1 and 11, contain less numbers of FBR, but the average weight of each piece of FBR is substantially greater than in Area 2 (Table 19). This is predictable given the fact that the peripheral areas of the camp and processing site are less desirable camp locations than the core area resulting in less reuse of FBR. Alternately, it may be that the peripheral areas were the focus of other kinds of activities than those conducted in the core of the camp and processing site. At the present time the former hypothesis seems the most resonable for there is no indication in the non-FBR data base that would suggest specialized activities took place in the peripheral areas of the camp and processing site. The unique aspects of the individual excavation areas are discussed briefly in the sections below.

Area 1

The development area is located to the south of the core camp and processing site and encompasses both Areas 11 and 12. Much of the development is located adjacent to and on steeply sloped land forms. In the case of excavation units 1 and 2 there were no fragments of FBR recovered (Table 20). Even in areas of moderate slope such as units 3, 5, and 7 there were very few remains, but only a short distance away in unit 4 were the ground surface was nearly level, the amounts of FBR recovered increased substantially.

The correlation between degree of slope and the kinds of archaeological remains recovered was consistent through all of the areas, with the more nearly horizontal surfaces containing the majority of the remains. In the case of units 6, 8, 9 and 10 all of which were 1 metre squares, and all of which were located on nearly flat lying ground, it is notable that they produced the greatest amounts of FBR and that the individual fragments were of a similar average size (Table 20).

Table 19

Total Count and Weight of Fire Broken Rock Recovered from all areas

Area	Count	Weight (g)	x Weight (g)	FBR(kg)/m^3
1	967	40,453.8	41.8	5.82
2	9619	150,575.5	15.65	21.23
11	928	25,171.3	27.1	1.80
12	94	1,083.4	11.5	0.19
TOTAL	11608	217,284.0	18.7	6.52

Table 20

Count and Weight of Fire Broken Rock Recovered From Area 1

Unit	Count	Weight (g)	x Weight (g)	FBR(kg)/m^3
1	-	-	-	-
2	-	-	-	-
3	14	210.2	15.0	0.08
4	138	12,040.3	87.25	13.38
5	1	18.3	18.3	0.02
6	223	8,059.3	36.1	20.15
7	39	1,896.6	48.6	2.92
8	90	3,826.3	42.5	9.57
9	260	8,151.8	31.3	13.59
10	202	6,251.0	30.9	12.50
TOTAL	967	40,453.8	41.8	5.82

Area 2

This area contained 83% (by count) of the total FBR assemblage from the 1983 field investigations. Notably this represents only 69% of the assemblage by weight, reflecting the smaller sized fragments of FBR recovered in Area 2. There was also a large range of variation in both the density of FBR (i.e., count/m^3) and the average size of the fragments recovered from the various excavation units (see Table 21). Units 1, 2, 4 and 6/21 yielded the highest counts of FBR for the area, with Unit 4 producing the greatest number of items. All of these units are located on relatively flat lying areas of the camp and processing site with Unit 4 being the most nearly level ground. It is also evident that Unit 4 is positioned in close proximity to the jump site and has the added advantage of being upwind of the kill. Units 7 and 20 were located in the stream gully that divides the camp and processing site and revealed the only well stratified deposits discovered at H.S.I. to date (see Figures 84 and 85). Unfortunately the demands of the mitigative component of the 1983 field investigations would only allow for a profile face to be cut in the gully bank, and very little was recovered from these profile units (Table 21). Unit 6/21 produced a great deal of small FBR but relatively few pieces per volume excavated when compared to Unit 4. This is the result of the large pit feature located in Unit 6/21, which contributed to the recovery of many small FBR fragments resulting from fine screening of the feature matrix. This in turn deflates the average size of the individual pieces recovered in the vicinity of the feature (Table 21). When comparing the total weight of FBR recovered from the units it is evident that Unit 1 produced the largest sized fragments of FBR, they were however, not nearly as concentrated as those found in Unit 4. It is postulated that the location of Unit 1 near the top of the slope leading to the kill site was a peripheral activity area. The local slope was not extreme by any means but may have been sufficient to promote the preferential occupation of more nearly level ground immediately to the south (i.e., near Unit 4).

Area 11

The bulk of the parking facilities for the VRC were located within the boundary of Area 11. Despite the large number of excavation units

Table 21

Count and Weight of Fire Broken Rock Recovered from Area 2

Unit	Count	Weight (g)	x Weight (g)	FBR (kg)/m^3
1	1773	46,976.0	26.5	23.49
2	1718	36,125.0	21.0	22.58
3	611	12,677.3	20.7	10.56
4	3303	31,869.4	9.65	79.67
5	35	1,350.0	38.5	3.38
6/21	2123	18,885.7	8.9	17.17
7	26	1,542.4	59.3	*
20	30	1,150.0	38.3	*
TOTAL	9619	150,575.5	15.65	21.23

* profile face only

(Table 22), the total amount and weight of FBR recovered from Area 11 was remarkably low. The ratio of kilograms of FBR per cubic meter is typically in the range of 2 kg or less. The only exceptions to this are Units 8 and 9, and in the case of Unit 9 the increased ratio is due to the presence of a feature which contained numerous pieces of FBR. By and large the entire area is characterized by a rather thin mantle of FBR with a comparable fragment size between Areas land 11. Area 11 is interpreted to be the result of periodic use of the peripheral areas of the camp and processing site, and was never the focus of intensive processing activities. The proximity of a currently active spring head may have influenced the location of some activities within Area 11.

Area 12

This small excavation area is located immediately south of Area 11 and contained only 4 excavation units (Table 23). In most respects Area 12 was similar to areas 1 and 11, with the exception that the average weight per fragment is substantially less than the latter two areas. The fact that Area 12 is located the greatest distance from the kill site may explain the low incidence of FBR, as well as other material culture remains.

Material types

It was noted earlier that both sandstone and quartzite rock were present in the HSI FBR assemblage. The locally available sandstone was used in minor quantities as indicated by a distinctive reddish colour, with the bulk of the FBR consisting of quartzite cobbles derived some distance from the site. Other researchers have attempted to quantify the heating properties of sandstone (House & Smith 1975) in addition to other material types. Brief experiments during the 1983 field investigations indicated that the local sandstone could be easily heated and used to boil water, and unlike the quartzite was not as susceptible to fracture and could be reused many times. It is possible that the sandstone would introduce a significant amount of sand particles into the liquid being heated and may therefore have only been used for specialized purposes, and not as conventional boiling stones. Also, we suspect the sandstone is less effective in the heat transfer process.

Table 22

Count and Weight of Fire Broken Rock Recovered from Area 11

Unit	Count	Weight (g)	x Weight (g)	FBR (kg)/m^3
1	30	575.0	19.2	0.72
2	30	580.0	19.3	0.39
3	73	1,025.0	14.0	1.71
4	40	817.5	20.4	0.82
5	39	2,965.7	76.0	0.93
6	58	1,128.25	19.5	9.90
7	26	550.0	21.1	1.10
8	163	2,129.0	13.0	3.04
9	413	14,851.6	36.0	9.90
10	27	314.3	11.6	0.39
11	29	235.0	8.1	0.29
TOTAL	928	25,171.05	27.1	1.81

Table 23

Count and Weight of Fire Broken Rock Recovered from Area Twelve

Unit	Count	Weight (g)	x Weight (g)	FBR (kg)/m^3
1	45	365.0	8.1	0.20
2	6	83.0	13.8	0.04
3	19	241.3	12.7	0.30
4	24	394.1	16.4	0.19
TOTAL	94	1,083.0	11.5	0.19

Experiments during the 1984 field season will focus on the quantification of heating properites for both sandstones and quartzites. In addition, the heating properites of bison chips will be contrasted with wood fuel to determine if this may have had an influence on the choice of fire stone. At HSI there is no local supply of wood fuel and it is assumed that the abundant supplies of buffalo chips would have constituted the primary fuel. The FBR experiments will also include the replication of boiling pit features, and the two rock material types will be evaluated for use as boiling stones. It is felt that these kinds of experiments will not only help to determine the ability of local rock materials but will also assist in understanding the complete processing activities associated with Bison procurement at HSI.

SECTION FIVE

GENERAL INTERPRETATIONS AND SPECULATIONS

CONSIDERATIONS

In this section of the report we intend to provide some initial interpretations and speculations on the data recovered during the 1983 field season. While tempted to expound on numerous topics relating to what we have learned about HSI from our 1983 studies, such temptation must be restrained by virtue of the nature and objectives of our first season at the site. Specifically, the requirements of the mitigation program caused us to test and excavate in areas peripheral to the main site where cultural materials were often scarce. Also, these excavations were necessarily widespread so as to cover all proposed development facilities resulting in a lack of detailed information on any one area. The non-development excavations conducted in the main processing area (Area 2) were also scattered over a wide area, this time by choice. This approach reflected our desire to gain an idea of the nature and extent of the cultural materials over a large part of the processing area, as few details of the archaeological assemblage of the area have been provided by others who worked there (Reeves & Wettlaufer).

The analysis of lithics, bone, FBR, ceramics and features from a series of non-contiguous units placed over a distance of more than a kilometre is at best speculative and preliminary. More than anything else, the 1983 results point the way to future studies designed to explore some of the suspicions and problems identified in our initial season. The final section of the report will discuss some of the future studies which we feel will make significant contributions to our knowledge of the site and to Plains prehistory and communal buffalo hunting. Here we intend to provide some preliminary discussion of a few of the topics which are logically suggested by the analysis of the excavations and recovered artifacts from the 1983 season. Settlement patterning, site seasonality and site community patterning are three topics which serve to encompass our thoughts about the results of our excavations, and to highlight some of the research results.

SETTLEMENT PATTERNING AND SEASONALITY

The immense size of the HSI site complex can lead toward viewing the site as its own little world. Yet certainly the site never existed in a vacuum, but rather was part of a broadly based seasonal round of prehistoric hunters. Such would be strongly suggested by descriptions of northern Plains Indian life provided by explorers, missionaries and ethnographers. Peter Fiddler, who wintered in the Porcupine Hills with the Piegan in 1792-93, provides graphic and insightful descriptions of almost daily attempts to run buffalo over cliffs or into other forms of traps (Fiddler 1792-1793). These attempts employed the use of horses and there can be no doubt that the enhanced mobility of the Plains Indians had a profound effect on the processes and timing of bison kill episodes (Ewers 1955). Grinnell (1893), Wissler (1910), and Ewers (1958) all provide ample documentation of the importance of communal kill events among the Blackfoot Indians, but at the same time stress the role of multiple resource procurement techniques over a broad region.

It is reasonable to assume that, despite the evidence of an impressive input of human labour to build and maintain the HSI complex, this site was only a small part of the seasonal and yearly lives of the local inhabitants. Numerous other buffalo jumps are known from southwestern Alberta; including the Shaver jump some 20 km southwest of HSI, the Pincher Creek jump some 40 km southwest, the Brocket jump about 35 km southwest, the Old Woman's jump some 60 km north, and the Fort Macleod jump 20 km east of HSI. Though only the Old Women's Jump has been excavated (Forbis 1962), artifacts collected from other jumps suggest all the sites were used in the Late Prehistortic Period and are probably contemporaneous. We agree with Reher and Frison (1980) that a regional cluster of jumps and other traps would be utilized by related bands of hunters depending on such factors as local environmental setting, local forage conditions, herd location and composition (age and sex), and the degree and kind of previous hunting episodes at specific sites.

A detailed and reliable settlement pattern for the HSI region cannot be reconstructed at this time. This is due primarily to the lack of other excavated sites in the vicinity - both camp and kill sites.

Numerous sites are known to exist in the Oldman drainage basin, especially on the margins of the Oldman River and tributary coulees (Reeves 1983a). Only the Kenny Site, a stratified Late Prehistoric camp in the valley bottom of Pincher Creek some 35 km southwest of HSI, has been well studied (Reeves 1983c). This site is interpreted as a winter camp, consistent with the model that sees Plains Indians moving into sheltered river, creek and coulee bottoms for fuel and shelter from the winter storms (Grasspointner 1981; Arthur 1975). We expect that the several prominent coulees which originate within a few hundred metres of HSI and feed into the Oldman River Valley would have provided access routes to the broad flood plains of the Oldman. We have unconfirmed reports of major winter camps situated on these flood plains at the mouths of these coulees (William Big Bull, pers. comm.). It is tempting to suggest that the fall or winter kill events at HSI were followed by movement of people and bison remains down these coulees to winter camps in the valley bottom. In a similar vein, winter camps situated in the valley bottom could muster personnel and resources to venture up the coulees to conduct communal kills throughout the winter and into the spring. These speculations will have to await future field studies.

While emphasizing the place of HSI in an overall settlement pattern it is also tempting to speculate on the possible territorial tendencies of the resident aboriginal groups. Head-Smashed-In represents one of the largest and most complex jump systems currently known. The labour invested in constructing the dozens of kilometres of drive lanes, coupled with the obvious success of the complex as evidenced by the 11 m of stratified bone deposits below the cliff, may have led to an inclination to defend and protect this site above most others. Who may have controlled the jump and who it was protected from is, of course, entirely speculative. Ewers (1955) Wissler (1910) and Grinnell (1893) concur that the Blackfoot peoples are relative newcomers to the southwest Alberta area, having originated somewhere to the northeast, possibly central Saskatchewan or Manitoba. Their movement to the Plains was believed to be prehistoric and not occasioned by historic Euro-Canadian expansion. Ewers (1955) estimates that the Blackfoot began their movement from an eastern homeland a few hundred years before the historic period, but had not yet arrived in their current territory of southern Alberta when historic contact occurred on the east coast. Reeves (pers. comm.) disagrees, believing instead that at least the Piegan band of the Blackfoot nation has occupied southwestern Alberta for a considerable period, perhaps the last 1000 years. Reeves (1983b) has suggested that the Old Woman's material culture complex represents prehistoric Piegan people.

On the basis of rock art styles at Writing-on-Stone, Keyser (1977) has suggested a pre-Blackfoot Shoshoni occupation in south central Alberta. Movement of Kootenay Indians from their current home in southeastern British Columbia across the Rockies into the Alberta prairies is well documented for the historic period (Turney-High 1941). Suggestions have been made regarding the possibility that Kootenay were the prehistoric occupants of the southwestern Alberta area and were driven westward over the Rockies by the Blackfoot (Turney-High 1941; Schaeffer 1981).

We believe that it is not yet possible to equate cultural materials at Head-Smashed-In and other nearby sites with any particular ethnic or cultural group. Thus the question of whether or not the jump was a facility which was coveted and perhaps even protected by one or more groups through time cannot be seriously addressed until better relationships between material culture and ethnic identity are established.

Regardless of whether or not HSI was protected or defended, groups using the site were obviously involved in a broad based settlement and resource procurement system that likely involved the known jumps from this area as well as many undiscovered kill and camp sites. The periodicity of the use of HSI and other kills cannot be determined. Even the deep, stratified bone deposits from the HSI kill site are not sufficient to permit refined estimates of the intervals at which the site was used. As far as we know, of the excavated multi-component Plains kill sites only the Vore site in Wyoming possesses the fine stratigraphic separation necessary to demonstrate the intervals of site use. Reher and Frison (1980) have calculated that the Vore site was used an average of every 25 years for a period of some 350 years. Intuitively we suspected that HSI was used at more frequent intervals, possibly every year, yet we have no supporting evidence for this. Our suspicions are again based on the time and labour investment evident at the site, and the amount of cultural material present.

As with the interval of site use, the results of the 1983 excavations do not provide sufficient data to address the question of seasonal use of the site. The bone recovered from the processing area was in general poorly preserved, and was characterized by ample evidence of natural and cultural modification and breakdown. Foetal bone was recovered in very small amounts, but as Arthur (1975) and others have pointed out some foetal bone may occur in a herd at almost any time of year. The most useful bone elements would have been mandibles with teeth in place, where tooth eruption and tooth wear have been shown to be reliable indicators of age (Frison 1970; Reher and Frison 1980). Unfortunately, mandibles with teeth were rare, and those recovered were almost invariably in poor condition. A few well preserved mandibles were found within feature matrices of subsurface pits, but this represents too small a sample to be of use as a seasonal indicator.

It is quite possible that the nature of the faunal material present at the processing site will never permit the determination of seasonality, at least using current methods. It is hoped that the planned attempt to discover and excavate additional features during the 1984 mitigation studies of the parking lot and access road may eventually increase the necessary faunal sample. This will not, however, resolve the problem of compressed multiple occupations causing uncertainty over the association of materials. In an analysis of the HSI fauna from Reeves' excavations of the kill site it was suggested that fall kills were the most common, but that other seasons were represented (Lifeways 1979). Speth (1983) has developed a provocative model which is based on the premise that the dietary needs of prehistoric hunters will structure the butchering practices at bison kill sites. His model would predict that the archaeological residue of spring kills should indicate preferential butchering of males, while at spring kills the females would be preferred. This is because of the relatively superior physical and nutritional condition of the different sexes in different seasons. The small sample and poor preservation of the 1983 faunal assemblage from HSI unfortunately precludes sexing of the bison remains. Dale Walde, a graduate student from the University of Victoria, is currently attempting to sex some of the fauna recovered by Reeves from the kill site deposits. Should this prove successful, and if future excavations at HSI supply us with larger and better preserved fauna from the processing area, we hope to evaluate Speth's model. Explicit predictions can be formulated regarding the expected faunal remains in both the kill and processing area should Speth's model of prehistoric behaviour be correct. At present, however, we do not have the data needed to test this model.

COMMUNITY PATTERNING

The previous discussion of settlement and subsistence practices provides a broad frame of reference which can be used to speculate on the seasonal movements of the prehistoric groups who utilized the HSI buffalo jump. There is yet another aspect to this settlement patterning, however, and that involves the evaluation of community level patterns. Unlike settlement patterning which focusses on the regional perspective, community level patterning is concerned with the structure of the individual site. In the case of HSI we are interested in the evaluation of artifact and feature distributions over the camp and processing site to determine where and how prehistoric groups may have apportioned their activities within the site boundaries. This helps to establish whether particular prehistoric groups have used all, or only portions of the camp and processing area, and whether some parts of the site were used exclusively for specific kinds of activities. The existence of such community patterning is felt to be manifest in the discrete distribution of time sensitive projectile point types, and the restricted distribution of particular kinds of material remains (ie. FBR, bone elements, features).

Recognition of community level patterning is hampered by the fact that much of the camp and processing site has been reoccupied many times, thus obscuring the evidence of individual events, or occupations. In addition, the camp and processing site is a deflated deposit and this results in the intermixing of the artifactual remains of separate occupations which further complicates the identification of community level patterning. Ideally, community level patterning should be evaluated on the basis of contiguous excavation areas such that spatial relationships of artifacts and features might be identified. Unfortunately the sample of artifacts and features currently available from HSI is derived from relatively small excavation units that are widely spaced over the camp and processing site. Despite the limitations of the available data base the analyses to date have provided some suggestion of community patterning in the distribution of artifactual remains; notably FBR, fauna, and chipped lithic tools. In some cases the patterning of remains is founded on the basis of negative evidence for particular kinds of remains in various areas of the site. Further excavations of the camp and processing area, with particular emphasis on the recording of contiguous units, will be necessary before the speculative comments that follow can be accorded any significance.

Previous excavations of the camp and processing area (Reeves, field notes 1965 and 1966) have not been reported on in detail, but they do suggest that material remains are not uniformly distributed over the prairie flats below the main kill site. This suggestion of differential useage of the camp and processing site was corroborated by the results of our 1983 surface survey and exploratory excavations within the camp and processing site.

The structure of the camp and processing site appears to be one of a core area on the prairie flats immediately below the jump site, as well as an area of peripheral cultural deposits extending south of the core area and to the north of the spring channel that bisects the site (see Figure 2). Evidence for community patterning of the HSI camp and processing deposits is manifest in the depth of the cultural deposits, density of material remains (both in a horizontal and vertical perspective), distribution and character of the FBR assemblage, and the qualitative aspect of the faunal inventory.

As noted earlier the majority of the camp and processing site is a deflation surface, and several thousand years of prehistoric occupation are compressed into a dense layer of lithics, bone, FBR and loess. The depth of this deposit varies over the site area dependent upon the distance from the main kill site, and the nature of the local terrain. It is evident that the more nearly level areas of the site in close proximity to the killsite were preferred locations, and that as distance from the bone bed increases the amount and depth of material remains decreases proportionally. Such a distribution is perhaps predictable, for given the option of carrying several thousand kilograms of bison portions a short distance as opposed to a long distance, the former is usually preferable. This follows on the premise that the principle of least effort would apply when selecting areas for secondary butchering, meat drying and processing of bison by-products. That is, given equivalent conditions of slope and available raw resources, those areas in close proximity to the primary kill site would be preferentially selected over more distant areas. The core area of the camp and processing site supports this contention, and reveals both the greatest depth of cultural deposits as well as the greatest density of material remains. In addition, the qualitative aspects of the faunal remains and FBR agree with this suggested community pattern.

Few faunal remains from the core area were whole, and in general the condition of the bone suggests it has suffered extensive taphonomic reduction. This is thought to be the result of prolonged exposure to physical and chemical weathering and to repeated occupations of the core area and resultant disturbance of the earlier deposits via trampling, clearing of habitation areas, gathering of tipi weight rocks and construction of hearths, boiling pits and other structures necessary for the processing of bison remains. The FBR assemblage in the core area consists of dense deposits of heat fractured limestones, granites and quartzites with some sandstone materials, whereas the peripheral areas contain lesser quantities of FBR. Qualitatively the pieces of FBR in the core area are much smaller than peripheral areas, and suggest that recycling of FBR was more prevalent in the core area. If this area of the site was utilized on a regular basis it stands to reason that readily available FBR fragments of sufficient size would be recycled, prior to the gathering of source materials from more distant locations.

The distribution of lithic remains also supports the concept of a core area for the number and density of lithic remains is greatest within the excavation units immediately below the kill site. There is however, an apparent difference in the projectile point types found within the core and peripheral areas of the camp and processing site. Ron Getty (pers. comm.) supervised most of Reeves' excavations in the camp and processing site and noted that the excavation units located to the north of the core area produced a disproportionate number of early point varieties, including Pelican Lake and Besant types. The 1983 excavations in the peripheral areas to both the north and south of the camp and processing site also produced a number of Middle Prehistoric point types and the basal portion of a well made lanceolate point.

The core area, on the other hand, was dominated by the presence of late dating point types, such as Avonlea and Plains and Prairie Side Notched styles. The significance of this projectile point type distribution is open to conjecture given the limitations of the present sample, but some speculative comments can be offered.

It is evident from the results of the 1983 surface survey and test excavations (and field notes from earlier studies) that Late Prehistoric remains dominate the HSI artifact assemblage, and occur throughout the camp and processing site. It is similarily evident that Middle Prehistoric point types are recovered more often in the peripheral areas away from the core area, to the north and south of the main spring channel. This distribution could be the result of many factors, holding sample bias in abeyance for discussion purposes.

The overwhelming predominance of late dating point styles indicates that the most intensive use of HSI occurred during Late Prehistoric times. On the basis of current intra site point style distributions it is likely that Late Prehistoric peoples occupied all of the camp and processing area, but the core area was clearly the most intensively occupied. Although the early point varieties of the Middle Prehistoric Period are well represented in the kill site deposits, (Reeves 1978) they are sparsely represented in the current sample from the camp and processing site. The preferential distribution of these early point varieties within the peripheral areas of the processing site suggests that the community level patterning at HSI may not have been the same during all time periods. This distribution could be the consequence of sample bias, in that early occupations were smaller and less intensive than those of the later prehistoric period. The possibility also exists that these early groups may have restricted much of their activities to the primary kill site and were not pursuing the extensive secondary processing of bison remains that appears to characterize the Late

Prehistoric Period. Alternatively the distribution of the early point types may have been the result of restricted use of the camp and processing area. The location of these processing activities within the peripheral zones of the camp and processing site could have been influenced by a variety of factors.

We can speculate that during repeated useage of HSI by prehistoric groups the same areas of the camp/processing site would be used over and over. The impression derived from ethnohistoric documentation is that camps were structured, and that the location of individual family campsites and activity areas was an ordered arrangement based upon the presence of other family units and influenced by kinship ties and the social hierarchies represented within the group. If such mechanisms are extrapolated to the prehistoric setting it is possible to envision the discrete activity patterning that would result if the early groups occupied traditional areas within the camp and processing site. This is not meant to imply that early groups had exclusive campsites within the camp and processing area, for certainly they would be free to use most or all of the extensive prairie flats. It is suggested however, that groups utilizing the HSI buffalo jump over the course of many generations may have habitually returned to the same area of the site and that major changes in the use of horizontal space at HSI reflects major changes in who is using the jump. In the case of the HSI data it is speculatively suggested that the peripheral areas of the camp and processing site may have fulfilled the role of a traditional camp area during the Middle Prehistoric use of the jump facility. The early groups using HSI are presumed to have constituted a low population density and would thus allow the hypothetical usage of only a small area of the camp and processing site. Alternately, the peripheral zones of the site may represent occupations that were not associated with the use of the jump facility. However, the nature of the faunal remains and lithic assemblage strongly argue for a direct correlation between the peripheral areas and the activities represented by the main kill deposits.

These very tenuous speculations, however, do not address the heart of the issue; which is <u>why</u> people using the site during Middle Prehistoric times decided to occupy the more peripheral areas of the camp/processing site (if indeed they did so). We have already stated our belief that the processing of a vast bulk of bison remains would likely be conducted in the closest suitable location; at HSI this being the flats of the "core" area below the kill. Does the apparent preference for the more peripheral site area in Middle Prehistoric time indicate a shift in the actual location of the kill itself? Reeves' recovery of Middle Prehistoric materials from the main kill site does not support this. Perhaps resources were present in these peripheral areas - such as water, wood and brush for fuel - which are no longer present but which would have made these areas more attractive in the past. We cannot answer these questions at this time.

In the final analysis the distribution of artifacts and features at HSI demonstrates only that there was a core area within the camp and processing site, and that this core area was most intensively occupied during Late Prehistoric times. There is a suggestion, based on an admittedly small sample, that some early point varieties occur more often in the peripheral areas of the camp and processing site, and that this can be tentatively interpreted as a pattern in the prehistoric use of HSI. Such community patterning is thought to be the result of intentional selection of some areas of the main processing site by individual groups of prehistoric peoples. Further excavations will hopefully serve to refute or support this speculative interpretation.

SECTION SIX

DIRECTIONS FOR FUTURE STUDIES

The 1983 season at Head-Smashed-In Buffalo Jump marked the commencement of field studies by staff of Alberta Culture. Primarily, this season was devoted to mitigative archaeological investigations necessitated by the planned development of the site for public interpretation. Secondarily, we utilized remaining time and resources at the site to conduct exploratory studies of the camp/processing site adjacent to the kill. These latter studies were motivated by two needs: 1) to acquire additional information about the operation and archaeology of the site with which we can augment the interpretive program presented to the public; 2) to initiate long range research studies of those aspects of HSI which are as yet poorly understood. Both of these needs are predicated on the fact that the bone bed of the kill site has already been intensively studied and given the UNESCO World Heritage designation and there is an obvious need to conserve the deep, stratified record of communal bison killing for future generations.

Head-Smashed-In is a site of enormous size and complexity, and while we feel we have learned much about the site after this first season, we also have learned enough to recognize the vastness of our ignorance about HSI. In this final section of the report we will briefly discuss some of the directions which we feel future studies at HSI should take.

Although we feel we have successfully completed most of the needed mitigative studies associated with site development, it is apparent that over the 1983/84 winter there have been a number of changes to the development plans which will necessitate further work. The location of the interpretive building has not changed, and only monitoring of the foundation excavations will be required. The access road from SR 516 to the parking lot(s) and building appears to be essentially fixed, and corresponds to that tested as the second access road. Monitoring of topsoil stripping and probably feature excavation will be required for the development in 1984. Locations for the septic field, well, water and power lines are all entirely unknown at this time and will have to be dealt with as specific plans arise.

As of this writing it is clear that the parking lot locations are in a state of flux. Proposed lot locations tested in 1983 are under review and it seems certain that some new parking areas will have to be examined in 1984. Indications are that parking areas closest to the interpretive building will be eliminated, with new parking lots placed further to the south alongside the access raod. We regard this as healthy, from an archaeological perspective, as the amount of cultural material decreased markedly as one moved south from the building site. Nevertheless, some additional testing of new lots will be required in 1984.

Other mitigation studies at HSI are more long range and cannot be identified at this tme. For example, once the interpretive centre is completed landscaping of the surrounding area will be required. Also, a trail network will be designed to take visitors from the centre to various points of interest on the site. Trails will be designed so as to minimize impact to archaeological resources, yet some mitigative studies may be necessary. These, and other unforeseen developments will be occurring over the next several years.

More germaine to this final section are future studies at HSI which have as their goal either an enhancement of the proposed interpretive program, or an advancement of our basic knowledge of this site and Plains prehistory. Many of the studies proposed for the 1984 and future seasons will, of course, contribute to both of these goals.

Several prehistoric features are situated within the HSI site area which are, or may be, related to the use of the site but which are presently poorly known. We refer specifically to the system of drive lane cairns, the petroglyphs, and a vision quest site. All three of these features have been known for some time (Junius Bird recorded the existence of the petroglyphs in 1938), but none have been seriously studied and reported on.

The drive lane system, based on the general description provided by Reeves (1978), is believed to be the most extensive and complex of all the known communal kills in North America. A detailed mapping of all drive lanes in the collecting area to the west of the kill site is currently being conducted under contract by B. Reeves. This study should result in a precise record of the locations of those lanes not removed by agriculture, roads, or other disturbances. This will allow for a quality reproduction of the drive lane system in the Olsen Creek basin in both model and mapped form within the VRC.

We also feel that it is necessary to further explore the specifics of the drive lane system in order to enhance the interpretive program. As observed today, the cairns of the drive lanes are small, low clusters of rocks just above the existing prairie surface. We propose that the 1984 season at HSI explore the specifics of cairn construction by choosing a small number of cairns for excavation. Four or five cairns will be excavated to clear away all dirt from the base of the lowest level of rocks. The number of rocks in each cairn will be counted and approximate sizes recorded. The rock types used in construction will be identified, and percentages calculated for the various rock types utilized. Drawings and photographs of the exposed cairns will be obtained. Finally, an attempt will be made to determine the source of the rocks used, and from this we may be able to speculate on the time and labour invested in drive lane construction. All of this information is seen as useful to furthering the knowledge of communal bison kills (where little attention has been paid to the details of rock cairns), and should provide site details which are expected to be of considerable interest to the general public.

In a similar vein, we propose to conduct detailed recording of the petroglyphs known to exist on top of a prominent bedrock knob about 1 km southwest of the primary kill. These glyphs are situated on flat, exposed slabs of sandstone bedrock overlooking the south side of the broad channel which forms what Reeves (1978) called the south pass leading from the gathering basin to the kill. Exploring the north side of this same channel in 1983 we observed additional petroglyphs on hoodoo-like sandstone boulders. The occurrence of glyphs on both sides of the channel which we believe was the main route for driving bison to the kill site is likely not coincidental. Glyphs or pictographs have been found in association with several other buffalo jumps in Alberta (Brink 1981), and it can be suggested that there is some correlation between the two. Whether or not the rock art at buffalo jumps is part of the elaborate ceremonial activity which preceded these communal events, (see Verbicky-Todd 1984), or whether they simply represent idle scratching of hunters waiting for the approaching herds cannot be determined at this time. Either way the rock art is of interest to the general public. We propose to record, map, draw and photograh the glyphs at HSI for the interest of public visitors. Some analysis of the glyphs, which consist mainly of simple parallel grooves, will also be attempted.

The third site feature to be explored is a presumed vision quest site located on top of a high hill about 1 km north of the kill site. Here, on the highest point for many square kilometres, are found the remains of two stone structures believed to be vision quest structures, and an assortment of rock alignments including small circles and ladder-like lines of rocks. Vision quests were a common part of Plains Indian culture (Lowie 1954) and approximately 15 vision quest sites are known in Alberta (J. Dormaar, pers. comm.). Thus the presence of this site near HSI may not be connected with the operation of the jump (its setting is entirely consistent with that of other vision quest sites), but it is again regarded as a feature which would be of interest to the public. The interpretive program for HSI calls for the delivery of information about a number of subjects aside from just that pertaining to buffalo jumping. The general culture of northern Plains Indians will be described, and the vision quest activity will be explained.

Accordingly we propose to record this site in 1984 through mapping and photography of the site area and the individual features. Details such as the size and type of rocks used will be recorded, as will the likely sources of these rocks. Exposing a few rocks will provide information on the amount of sediment accumulation since feature construction. Small test excavations may be conducted in an attempt to find associated artifacts.

Aside from any excavations necessitated by our monitoring of development area surface stripping, the major excavation planned for the 1984 season is a block excavation of a part of the processing area to the north of the spring channel. As has been stressed above, the 1983 tests of the processing area on both sides of the spring channel revealed a massive deposit of cultural materials. While rich in lithics and faunal material the lack of soil deposition and the obvious repeated use of the area has produced an assemblage of enormous interpretive complexity. While we believe there is a wealth of information about bison processing contained in these deposits, and by no means are we "writing off" further studies of the area, we feel that the relatively short mandate of Alberta Culture staff at this time - probably two more field seasons, or until the interpretive building opens - is insufficient to permit the magnitude of study required. Instead we feel that a major study of the main processing area should wait until the interpretive facility opens and a long-term public archaeology program is initiated. On site studies by an archaeological crew are envisioned to continue for many years, possibly decades, presenting an ideal opportunity for ongoing investigations of this complex archaeological record.

Our widespread and isolated test units excavated in 1983 have given us a fair picture of the nature and the remains in the processing area and have stimulated our interest in pursuing a series of questions concerning final butchering processing and rendering of bison remains. We propose to pursue this interest by conducting a modest block excavation in an area where we have reason to believe the archaeological record may be less complex than that of the main processing area. Specifically we plan to move about 150 m north of the spring channel onto the crest of a minor topographic undulation where a few rock features were observed in 1983. At least one tipi ring and several probable rock hearths are indicated by partially buried rocks. While we expect no stratigraphy or vertical separation of archaeological deposits in this area, the presence of certain rock features will at least allow us to commence excavations with the premise of an imposed structuring of the data base. Equally important, the increased distance from the main processing area should result in a more simplified archaeological record based on the assumption that less people came here less often to conduct activities associated with bison processing. The virtual pavement, and seemingly patternless arrangement of cultural material observed in the main processing area will hopefully be replaced by evidence of discrete activities and associated artifacts unencumbered by the disturbances associated with repeated occupations. It is anticipated that the excavation of approximately ten contiguous 2 m^2 units will be sufficient to document the activities and assemblage in and around the rock features. If results suggest that indeed discrete patterns of data exist, and if resources permit, a larger area may eventually be opened. The recovery and analysis of materials from these excavations should provide an excellent beginning to our intended research focus on the processes and events associated with bison processing.

Finally, we plan to initiate a series of experiments in 1984 which will complement and augment our study of the archaeological residue of bison processing. These experiments will have two main objectives: 1) to explore the mechanics, operation and residue of bone boiling pits; and 2) to observe the long-term effects of natural bone destruction. Using both sandstone and non-sandstone materials we will conduct bone smashing and boiling experiments with bison bones in a bison hide-lined pit. The experiments will be controlled and quantified with the aid of a thermocouple unit for measuring air, hearth and pit temperatures. Ethnographic data from the northwest plains will be employed to model the experiments. The focus of the experiments will be to carefully record the residue of the various activities including hearth stains, FBR alteration and patterning, fragmented bone size and distribution, and pit features in terms of content and the spatial association of all related materials.

The experiments with natural bone destruction are very much related to the bone boiling experiments in that our 1983 excavation results suggests a great potential for confusion between fragmented bone produced by cultural processing and that produced by natural taphonomic processes. We suspect the severe environment at HSI and the low rate of soil deposition resulting in prolonged exposure to this environment has produced a bone assemblage much like that one would expect from the cultural processing of bone for grease extraction. To help quantify the nature of natural bone destruction we plan to spread a variety of fresh bison faunal elements across the general site area. The exact positions of the bone would be mapped to aid in relocating the specimens and to check for subsequent movement. The bones would be naturally subjected to most of the same taphonomic processes operative in the past at HSI including cattle trampling (as an analog for bison trampling), small rodent and scavenger disturbance, and physical and chemical erosional forces which probably differ little from those operating in the prehistoric period. Only the disturbance caused by reuse of the site by prehistoric hunters will be absent from the experiments. The bones will be laid out in the 1984 season and will be inspected periodically for a number of years to measure and record the impact of natural processes.

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APPENDIX 1

The 1983 Tests Excavation in the Spring Channel at Head-Smashed-In Buffalo Jump, Alberta

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INTRODUCTION:

During the first week of August 1983, Jack Brink, Milt Wright, Peter Bobrowsky, Tim Schowalter and I examined the cut banks of the spring channel below the main kill area of the Head-Smashed-In Buffalo Jump and decided to open a test excavation to determine whether undisturbed, well stratified deposits could be found in that part of the site. Our attention was drawn to several faunal elements protruding from the bank in apparent associations that would not be expected to result from fluvial deposition. On 6 August, Milt Wright and I removed brush from a three meter wide area extending southward (upslope) from the south edge of the cut bank, and we shot in points from the grid system on which a test trench could be outlined. A series of excavation units were established (7-10), however time permitted excavation of only the two units which intersected the creek bank, numbers 7 and 20.

Excavation was begun by Tim Schowalter on 10 August when Levels 1-4 were removed from Units 7 and 20 (Figure 2), the partial squares truncated by the cut bank. On 11 August, I began work on Level 5 in Unit 7 and continued there until 17 August by which time Level 14 was nearly finished. Schowalter removed Levels 5-7 in Unit 20 on 11 August, and subsequent work in Unit 20 was carried on by K. Hardie, C. Hughes, H. Nelson, M. Rollans, L. Rose, and M. Wright. Both units were profiled by

Wright and Brink on 4 September, and additional excavation (Levels 15-16) in Unit 20 to a depth of 160 cm was conducted by Wright on 10 September.

This report is essentially descriptive and is intended to serve the following purposes: (1) interrelate the field notes, the catalogue, and the collections; (2) identify questions or problems in the documentation of the excavation; (3) place on record an analysis of recovered faunal remains; and (4) define objectives for future work in the HSI spring channel. A preliminary interpretive statement on the taphonomy of the fauna was presented at the 41st Plains Conference in Rapid City (Brink and Morlan 1983). Recovered bison and unidentified large mammal bones are presented by level in Tables 24-37 with a summary in Table 38. Table 39 tabulates frequencies of charred bone fragments by level, and Table 40 lists all non-bison elements that have been identified thus far. The artifactual remains recovered from the spring channel excavations are not discussed as these have already been reviewed in the body of the main report.

Level 1

Sediments: Apparently no notes were recorded for this level, but it removed the humus and a portion of the underlying dark brouwn silt to a depth of 10 cm below the surface.

Fauna: Only five bone fragments were recovered, and all were found in Unit 7 (Table 24). No artifacts were recovered.

Level 2

Sediments: An arbitrary level, 10-20 cm B.S., in homogeneous dark brown silt. Schowalter's notes for Unit 20 mention the appearance of "a bone layer just below the sandy soil ... may also be a layer at soft-hard interface with small poorly preserved bone pieces." Roots caused significant trouble in Unit 7 and may have been growing through a hearth.

Fauna: 97 fragments represent Bison or large unidentified mammal remains (Table 25). All the larger pieces occurred in Unit 7, but two large bones were left in place in the wall of Unit 20. A definite layer of bone occurred 16-20 cm B.S. in Unit 7 where a large bone remained protruding from the bank. A long bone fragment (#2857) is chipped back and polished on high spots on one end, probably by carnivore gnawing. A

Table 24
Level 1 Bison, H.S.I. Spring Channel

Cat. No.	Element	Side	Number	Weight	Mean Wt.	Percent Number	Percent Weight
UNIT 7							
2849	Coronoid	L	1.00	12.78	12.78	20.00	34.05
2851	Rib	Frag	3.00	4.27	1.42	60.00	11.38
2850	Longbone	Frag	1.00	20.48	20.48	20.00	54.57
TOTALS			5.00	37.53	7.51	100.00	100.00

Table 25
Level 2 Bison, H.S.I. Spring Channel

Cat. No.	Element	Side	Number	Weight	Mean Wt.	Percent Number	Percent Weight
UNIT 7							
2856	Cranial	Frag	1.00	1.35	1.35	1.85	0.88
2855	Cheek To	Frag	3.00	4.29	1.43	5.56	2.80
2854	Rib	Frag	2.00	8.91	4.46	3.70	5.81
2862	Rib	Frag	11.0	8.62	0.78	20.37	5.63
2853	Pubis	R	1.00	17.77	17.77	1.85	11.59
2863	Femur	Shaft	1.00	37.75	37.75	1.85	24.62
2857	Longbone	Frag	1.00	11.44	11.44	1.85	7.46
2852	Phalange	First	1.00	26.59	26.59	1.85	17.34
2858	Unclass.	Frag	5.00	9.76	1.95	9.26	6.36
2859	Unclass.	Frag	23.00	22.22	0.97	42.59	14.49
2860	Unclass.	Frag	3.00	2.19	0.73	5.56	1.43
2861	Unclass.	Frag	2.00	2.46	1.23	3.70	1.60
	TOTALS		54.00	513.36	2.84	100.00	100.00
						55.67	80.89
UNIT 20							
2687	Cranial	Frag	1.00	3.09	3.09	2.33	8.53
2688	Cheek to	Frag	4.00	4.51	1.13	9.30	12.44
2689	Longbone	Frag	1.00	0.45	0.45	2.33	1.24
2686	Sesamoid	Dist	1.00	1.45	1.45	2.33	4.00
2690	Unclass	Frag	14.00	20.64	1.47	32.56	56.95
2691	Unclass	Frag	22.00	6.10	0.28	51.16	16.83
	TOTALS		43.00	36.24	0.84	100.00	100.00
						44.33	19.11
	GRAND TOTAL		97.00	189.60	1.95	100.00	100.00

fragment of femoral shaft (#2863) was fractured when fresh, and a flake detached from the impact notch was embedded in the medullary cavity; it represents artificial fracturing, probably for marrow procurement. Only four small fragments exhibit charring.

Level 3

Sediments: Arbitrary level, 20-30 cm B.S., within dark brown silt. Large roots finally removed, and identity of hearth confirmed in Unit 7.

Fauna: Of 218 bone fragments, 70% occurred in Unit 7, but the distribution by weight between the two units is misleading (Table 26), because a large portion of a left mandible remains in the wall of Unit 7 with only the ascending ramus having been collected (#2864). Since the Unit 20 mandible is also from the left side, at least two individual bison are represented. Schowalter noted concentrations of bone fragments at 23 cm B.S. and at 27-30 cm B.S. in Unit 7, suggesting that there is internal stratification within this level. Charring was observed on 23 small bone fragments.

Comment: I believe that Levels 2 and 3 have arbitrarily split a primary occupation component and that future work in adjacent units should seek to define it more precisely. That it represents primary context is suggested by two large mandibles containing teeth and by the presence of a hearth containing FBR and pottery. The sherd in Level 3 could represent the same vessel as those in Level 2. Schowalter noted that the east half of Unit 8 yielded relatively little material, suggesting that remains of the occupation may be concentrated around the hearth.

Level 4

Sediments: Arbitrary level (in part), 30-40 cm B.S., in dark brown silt. Schowalter mentions a clayey harder material 25-35 cm B.S. in Unit 20. "This appears to be crossed by a number of burrows which contain bone. The clay-like harder material appeared not to have bone." In Unit 7 the level was terminated at the top of a dark layer containing charred bone near the face of the cut bank.

Fauna: In both number and weight the faunal remains were heavily concentrated in Unit 7 (Table 27). Fifty-eight small bone fragments are charred.

Table 26
Level 3 Bison, H.S.I. Spring Channel

Cat. No.	Element	Side	Number	Weight	Mean Wt.	Percent Number	Percent Weight
UNIT 7							
2874A	Cranial	Frag	1.00	3.91	3.91	0.51	1.45
2875A	Facial	Frag	1.00	0.88	0.88	0.51	0.33
2864	Ramus	L	1.00	72.90	72.90	0.51	27.04
2874B	Corpus	Frag	1.00	6.37	6.37	0.51	2.36
2865	Upper M2	L	1.00	34.68	34.86	0.51	12.86
2866	Cheek To	Frag	13.00	8.14	0.63	6.63	3.02
2873	Intervert	Disk	1.00	4.21	4.21	0.51	1.56
2869	Rib	Frag	1.00	1.44	1.44	0.51	0.53
2872	Sesamoid	Dist	1.00	2.33	2.33	0.51	0.86
2867	Unclass	Frag	23.00	17.12	0.74	11.73	6.35
2868	Unclass	Frag	124.00	49.37	0.40	63.27	18.31
2870	Unclass	Frag	21.00	5.274	2.51	10.72	19.56
2871	Unclass	Frag	1.003	4.48	4.48	0.51	1.66
2874	Unclass	Frag	5.00	10.40	2.08	2.55	3.86
2875	Unclass	Frag	1.00	0.60	0.60	0.51	0.22
	TOTAL		196.00	297.57	1.38	100.00	100.00
						69.75	42.98
UNIT 20							
2701	Mandible	L	1.00	236.76	236.76	1.18	66.21
2693	Upper P3	L	1.00	9.13	9.13	1.18	2.55
2696A	CheekTo	Frag	1.00	2.80	2.80	1.18	0.78
2699	Cheek To	Frag	2.00	1.61	0.81	2.35	0.45
2694	Rib	Frag	1.00	20.81	20.81	1.18	5.82
2702	Rib	Frag	1.00	14.23	14.23	1.18	3.98
2692	Tibia	L	1.00	22.12	22.12	1.18	6.19
2695	Unclass	Frag	46.00	12.24	0.27	54.12	3.42
2696	Unclass	Frag	13.00	25.23	1.94	15.29	7.06
2697	Unclass	Frag	2.00	5.74	2.87	2.35	1.61
2698	Unclass	Frag	14.00	5.83	0.42	16.47	1.63
2700	Unclass	Frag	2.00	1.08	0.54	2.35	0.30
	TOTAL		85.00	357.57	4.21	100.00	100.00
						30.25	57.02
	GRAND TOTAL		281.00	627.15	2.23	100.00	100.00

Table 27
Level 4 Bison, H.S.I. Spring Channel

Cat. No.	Element	Side	Number	Weight	Mean Wt.	Percent Number	Percent Weight
UNIT 7							
2887	Cranial	Frag	13.00	7.83	0.60	2.55	1.85
2880	Lower Me	R	1.00	37.48	37.48	0.20	8.87
2882	Molar 1/2	L	1.00	21.39	21.39	0.20	5.06
2885A	Incisor	Frag	1.00	0.59	0.59	0.20	0.14
2885	Cheek to	Frag	9.00	5.73	0.64	1.76	1.36
2883	Lumbar	Centrum	1.00	23.90	23.90	0.20	5.66
2888A	Rib	Head	1.00	1.85	1.85	0.20	0.44
2879	Rib	Frag	1.00	4.11	4.11	0.20	0.97
2886	Rib	Frag	5.00	8.94	1.79	0.98	2.12
2881	Scapula	L	1.00	24.87	24.87	0.20	5.89
2888B	Pubis	R	1.00	1.90	1.90	0.20	0.45
2884	Longbone	Frag	1.00	26.26	26.26	0.20	6.21
2876	Unclass	Frag	386.00	121.50	0.31	75.69	28.75
2877	Unclass	Frag	45.00	26.91	0.60	8.82	6.37
2878	Unclass	Frag	28.00	85.48	3.05	5.49	20.23
2888	Unclass	Frag	7.00	16.13	2.30	1.37	3.82
2889	Unclass	Frag	1.00	0.68	0.68	0.20	0.16
2890	Unclass	Frag	7.00	7.02	1.00	1.37	1.66
	TOTAL		510.00	422.57	0.83	100.00	100.00
						87.63	85.20
UNIT 20							
2709A	Cranial	Frag	1.00	1.34	1.34	1.39	1.82
2706A	Incisor	Frag	1.00	0.62	0.62	1.39	0.84
2706	Cheek To	Frag	1.00	1.62	1.62	1.39	2.21
2708A	Humerus	Head	1.00	14.20	14.20	1.39	19.34
2705	Longbone	Frag	6.00	12.35	2.06	8.33	16.82
2708	Longbone	Frag	2.00	6.01	3.01	2.78	8.18
2707	Sesamoid	Prox	1.00	2.84	2.84	1.39	3.87
2703	Unclass	Frag	44.00	19.73	0.45	61.11	26.87
2704	Unclass	Frag	12.00	4.62	0.39	16.67	6.29
2709	Unclass	Frag	2.00	4.18	2.09	2.78	5.69
2710	Unclass	Frag	1.00	5.92	5.92	1.39	8.06
	TOTAL		72.00	73.43	1.02	100.00	100.00
						12.37	14.80
	GRAND TOTAL		582.00	496.00	0.85	100.00	100.00

Level 5

Sediments: A natural level in dark brown silt that appeared even darker because of a high frequency of charred bone fragments. It contrasted strongly with the underlying light brown silt of Level 6. Fauna: Of 538 bone fragments, 65% occurred in Unit 7 (Table 28) and 105 (19.5%) exhibit charring. A small concentration of charred fragments was noted at 33.9-34.0S/30.4-30.5E. Only a right talus weighed more than 100 grams, and the next largest fragment, a left glenoid fossa, was seen to be tipped up on edge.

Comment: I believe that these first five levels together represent a major episode of aggradation in the spring channel in which sediments were deposited primarily by colluvial and aeolian processes, but it is possible that they comprise the silt "cap" of a fining-upward alluvial sequence that begins with Level 7 (see also Brink and Morlan 1983). Future excavation upslope from Units 7 and 20 should assist in settling this question by exposing the north-south attitudes of the sedimentary units. In any event, only Level 3 now appears to hold promise for primary archaeological deposits within this part of the sequence.

Level 6

Sediments: Natural level through light brown silt to a lighter gray-brown sandy silt.

Fauna: The 498 bone fragments were evenly divided between the two units, but two large elements caused 68% of the bone weight to occur in Unit 20 (Table 29). The two large elements, a right mandible and a right tibia, were found in contact with one another in a "concentration of charred bone and possible badly broken-down charcoal (in a) lens-shaped dark area" (Schowalter's notes). The right tibia, a shaft fragment (#2720), has been gnawed by a carnivore at the proximal end, and gnawing has obscured the anatomical features of one other fragment (#2731) from Unit 20. Only 38 fragments (7.6%) are charred.

Level 7

Sediments: Light gray-brown sandy silt was removed to expose a dark floor or organic-enriched silt (Level 8). In Unit 7 the sandy silt was

Table 28
Level 5 Bison, H.S.I. Spring Channel

Cat. No.	Element	Side	Number	Weight	Mean Wt.	Percent Number	Percent Weight
UNIT 7							
2898	Cranial	Frag	10.00	1.41	0.14	2.87	0.56
2895	Facial	Frag	1.00	2.07	2.07	0.29	0.82
2906C	Facial	Frag	1.00	1.64	1.64	0.29	0.65
2906D	Facial	Frag	1.00	1.08	1.08	0.29	0.43
2892	Coronoid	R	1.00	8.08	8.08	0.29	3.19
2904	Lower P4	R	1.00	5.15	5.15	0.29	2.04
2899	Cheek To	Frag	17.00	8.85	0.52	4.87	3.50
2903	Cheek To	frag	1.00	6.13	6.13	0.29	2.42
2897A	Vertebra	Centrum	1.00	1.44	1.44	0.29	0.57
2903	Vertebra	Frag	1.00	13.30	13.30	0.29	5.26
2905	Caudal	Frag	1.00	0.20	02.0	0.29	0.08
2896	Intervert	Disk	1.00	0.76	0.76	0.29	0.30
2906B	Intervert	Disk	1.00	0.87	0.87	0.29	0.34
2901	Rib	Frag	3.00	4.50	1.50	0.86	1.78
2891	Glenoid	L	1.00	35.05	35.05	0.29	13.86
2906A	Epiphysis	Frag	1.00	12.44	12.44	0.29	4.92
2893	Unciform	L	1.00	13.19	13.19	0.29	5.21
2894	Sesamoid	Dist	1.00	2.37	2.37	0.29	0.94
2896	Unclass	Frag	223.00	69.66	0.31	63.90	27.54
2897	Unclass	Frag	14.00	37.00	2.64	4.01	14.63
2900	Unclass	Frag	61.00	19.88	0.33	17.48	7.86
2902	Unclass	Frag	1.00	1.62	1.62	0.29	0.64
2906	Unclass	Frag	5.00	6.22	1.24	1.43	2.46
	TOTALS		349.00	252.90	0.72	100.00	100.00
						64.87	52.40
UNIT 20							
2717	Cranial	Frag	1.00	1.99	1.99	0.53	0.87
2719a	Cranial	Frag	1.00	0.76	0.76	0.53	0.33
2715	Incisor	Frag	1.00	0.16	0.16	0.53	0.07
2714	Cheek To	Frag	8.000	4.17	0.52	4.23	1.82
2711	Talus	R	1.00	130.56	130.56	0.53	56.83
2718	Sesamoid	Prox	1.00	3.22	3.22	0.53	1.40
2712	Unclass	Frag	129.00	41.46	0.32	68.25	18.05
2713	Unclass	Frag	37.00	19.01	0.51	19.58	8.27
2716	Unclass	Frag	8.00	15.59	1.95	4.23	6.79
2719	Unclass	Frag	2.00	12.81	6.41	1.06	5.58
	TOTALS		189.00	229.73	1.22	100.00	100.00
						35.13	47.60
	GRAND TOTAL		538.00	482.63	0.90	100.00	100.00

Table 29
Level 6 Bison, H.S.I. Spring Channel

Cat. No.	Element	Side	Number	Weight	Mean Wt.	Percent Number	Percent Weight
UNIT 7							
2917	Cranial	Frag	1.00	4.29	4.29	0.41	1.96
2920	Cranial	Frag	7.00	4.09	0.58	2.89	1.86
2919	Cheek To	Frag	2.00	1.33	0.67	0.83	0.61
2913	Thor 1	Transpine	1.00	11.70	11.70	0.41	5.33
2909	Thorl	Transpine	1.00	7.28	7.28	0.41	3.32
2921	Thoracic	Vert?	1.00	16.33	16.33	0.41	7.45
2918A	Thoracic	Prezyga	1.00	2.97	2.97	0.41	1.35
2907	Rib	Head	1.00	3.57	3.57	0.41	1.63
2908	Femur	R	1.00	11.43	11.43	0.41	5.21
2910	Metapod	Frag	1.00	10.41	10.41	0.41	4.75
2918B	Metapod	Frag	1.00	3.00	3.00	0.41	1.37
2912	Magnum	R	1.00	7.00	7.00	0.41	3.19
2911	Talus	L	1.00	26.50	26.50	0.41	12.08
2914	Unclass	Frag	168.00	38.36	0.23	69.42	17.49
2915	Unclass	Frag	30.00	14.90	0.50	12.40	6.79
2916	Unclass	Frag	21.00	38.93	1.85	8.68	17.75
2918	Unclass	Frag	3.00	17.25	5.75	1.24	7.86
	TOTAL		242.00	219.34	0.91	100.00	100.00
						48.59	31.95
UNIT 20							
2730	Facial Frag		5.00	1.44	0.29	1.95	0.31
2645	Mandible	R	1.00	189.79	189.79	0.39	40.62
2724	Cheek to	Frag	10.00	4.38	0.44	3.91	0.94
2728	Intervert	Disk	1.00	0.52	0.52	0.39	0.11
2727	Rib	Frag	1.00	1.75	1.75	0.39	0.37
2720	Tibia	R	1.00	125.79	125.79	0.39	26.92
2725	Metacarp	Five	1.00	6.00	6.00	0.39	1.28
2721	Unclass	Frag	130.00	49.37	0.38	50.78	10.57
2722	Unclass	Frag	8.00	15.86	1.98	3.13	3.39
2723	Unclass	Frag	80.00	28.01	0.35	31.25	6.00
2726	Unclass	Frag	13.00	30.21	2.32	5.08	6.47
2729	Unclass	Frag	3.00	5.05	1.68	1.17	1.08
2731	Unclass	Frag	1.00	5.97	5.97	0.39	1.28
	TOTAL		256.00	467.22	1.83	100.00	100.00
						51.41	68.05
	GRAND TOTAL		498.00	686.56	1.38	100.00	100.00

more than 10 cm thick, and it was removed in two sub-levels, 7A and 7B. Fauna: Level 7 seemed nearly sterile during excavation, and it yielded only 92 small bone fragments (Table 30) of which 16 are charred (17.4%).

Level 8

Sediments: Organic-rich silt with fine sub-angular blocky structure comprised a paleosol that was removed in three arbitrarily defined sub-levels in Unit 7 and as a single level in Unit 20. All matrix from Level 8A in Unit 8 was bagged for flotation.

Fauna: Of 433 bones and fragments from this level, 13 weigh more than 100 grams (Table 31), and 35 (8.1%) are charred. Unlike any other level, two of the charred bones from Level 8 are large elements, a left tibia fragment (#2942) and a cervical vertebra (#2649). All large elements, and many small ones, are shown in Figures 77-81. Evidence has been assembled elsewhere (Brink and Morlan 1983) to show that this assemblage is in primary context. In this report, emphasis is placed on evidence for butchering and for gnawing by carnivores. Nearly all confidently identified cut marks appear on vertebral transverse and neural spines, indicative of loin and rib section removal. One of these (a thoracic, #2651) is especially interesting, because the neural spine bears a cut mark on one side and both pierce and gnaw marks on the other where the transverse spine also exhibits a chop mark. A right talus (#2648) is cut on the medial face, and a rib head (#2946) is either cut or gnawed and exhibits polish near the break. A left mandible (#3050) is cut on the lower border and scraped on the ascending ramus, and a right mandible (#2646) is extensively scratched on the medial face of the corpus; the cut could be related to tongue removal, but I cannot interpret the scrapes and scratches. Carnivore gnawing appears on a fresh-fractured rib fragment (#2741) and on the iliac blade of an innominate (#2652). A left tibia (#2952) appears at first glance to represent a tool similar to the tibia choppers reported elsewhere (e.g., Frison 1978:306-307), but on closer inspection the damage on the break appears to have resulted from rodent gnawing; I cannot explain the polished appearance of this edge. Several elements (e.g., mandibles, tibiae, tali, 7th cervicals, and 1st thoracics) indicate that at least

Table 30
Level 7 Bison, H.S.I. Spring Channel

Cat. No.	Element	Side	Number	Weight	Mean Wt.	Percent Number	Percent Weight
UNIT 7							
2924	Cheek To	Frag	1.00	1.35	1.35	2.33	3.04
2922	Unclass	Frag	13.00	5.20	0.40	30.23	11.69
2923	Unclass	Frag	2.00	1.20	0.60	4.65	2.70
2925	Unclass	Frag	8.00	3.06	0.38	18.60	6.88
2926	Unclass	Frag	19.00	33.66	1.77	44.19	75.69
	TOTAL		43.00	44.47	1.03	100.00	100.00
						46.74	44.69
UNIT 20							
2660A	Cheek To	Frag	2.00	1.65	0.83	4.08	3.00
2732	Rib	Frag	1.00	1.09	1.09	2.04	1.98
2658	Phalange	Third	1.00	20.45	20.45	2.04	37.16
2660	Unclass	Frag	45.00	31.84	0.71	91.84	57.86
	TOTAL		49.00	55.03	1.12	100.00	100.00
						53.26	55.31
	GRAND TOTAL		92.00	99.50	1.08	100.00	100.00

Table 31
Level 8 Bison, H.S.I. Spring Channel

Cat. No.	Element	Side	Number	Weight	Mean Wt.	Percent Number	Percent Weight
UNIT 7							
2937	Skull	Frags	1.00	389.36	389.36	0.48	16.89
2944	Mandible	L	1.00	198.38	198.38	0.48	8.61
2934	Mandible	R	1.00	212.31	212.31	0.48	9.21
2929	Incisor	L	1.00	2.15	2.15	0.48	0.09
2930	Cheek To	Frag	1.00	3.07	3.07	0.48	0.13
2951	Cheek To	Frag	1.00	0.80	0.80	0.48	0.04
2959	Cheek To	Frag	4.00	1.53	0.38	1.92	0.07
2933	Axis	Frag	1.00	54.20	54.20	0.48	2.35
2939	Thoracic	First	1.00	140.59	140.59	0.48	6.10
2932	Lumbar	First	1.00	71.84	71.84	0.48	3.12
2936	Lumbar	Prezyga	1.00	6.31	6.31	0.48	0.27
2940	Intervert	Disk	1.00	7.82	7.82	0.48	0.34
2931	Intervert	Disk	1.00	3.13	3.13	0.48	0.14
2946	Rib	Head	1.00	9.74	9.74	0.48	0.42
2935	Rib	Frag	1.00	7.08	7.08	0.48	0.31
2941	Rib	Farg	1.00	39.90	39.90	0.48	1.73
2943	Rib	Frag	1.00	2.77	2.77	0.48	0.12
2945	Rib	Frag	3.00	4.99	1.66	1.44	0.22
2947	Rib	Frag	1.00	3.57	3.57	0.48	0.15
2948	Rib	Frag	1.00	3.69	3.69	0.48	0.16
2960	Rib	Frag	1.00	2.20	2.20	0.48	0.10
2960A	Rib	Frag	1.00	7.19	7.19	0.48	0.31
2953	Scapula	R	1.00	54.65	54.65	0.48	2.37
2956	Scapula	R	1.00	2.82	2.82	0.48	0.12
2954	Humerus	R	1.00	43.38	43.38	0.48	1.88
2938	Femur	R	1.00	285.51	285.51	0.48	12.39
2942	Tibia	L	1.00	137.87	137.87	0.48	5.98
2952	Tibia	L	1.00	530.96	530.96	0.48	23.04
2948	Longbone	Frag	1.00	6.04	6.04	0.48	0.26
2955	Longbone	Frag	1.00	9.55	9.55	0.48	0.41
2927	Unclass	Frag	20.00	6.72	0.34	9.62	0.29
2928	Unclass	Frag	3.00	1.39	0.46	1.44	0.06
2949	Unclass	Frag	18.00	4.43	0.25	8.65	0.19
2950	Unclass	Frag	67.00	27.69	0.41	32.21	1.20
2957	Unclass	Frag	57.00	18.45	0.43	27.40	0.80
2958	Unclass	Frag	8.00	2.89	0.36	3.85	0.13
	TOTAL		208.00	2304.97	11.08	100.00	100.00
						48.04	51.71

Table 31 (continued)

Cat. No.	Element	Side	Number	Weight	Mean Wt.	Percent Number	Percent Weight
UNIT 20							
2667	Cranial	Frag	23.00	10.59	0.46	10.22	0.49
2735	Cranial	Frag	1.00	1.86	1.86	0.44	0.09
2738	Cranial	Frag	1.00	1.19	1.19	0.44	0.06
3050	Mandible	L	1.00	632.12	632.12	0.44	29.37
2646	Mandible	R	1.00	388.65	388.65	0.44	18.06
2664	Cheek To	Frag	7.00	0.05	0.01	3.11	0.00
2649	Cervical	Three	1.00	103.37	103.37	0.44	4.80
2644	Cervical	Seven	1.00	175.51	175.51	0.44	8.15
2685	Cervical	Seven	1.00	148.01	148.01	0.44	6.88
2656	Thoracic	One	1.00	87.33	87.33	0.44	4.06
2651	Thoracic	Two-11	1.00	52.26	52.26	0.44	2.43
2647	Lumbar	Four	1.00	140.80	140.80	0.44	6.54
2736	Rib	Head	1.00	5.48	5.48	0.44	0.25
2650	Rib	Frag	1.00	3.86	3.86	0.44	0.18
2741	Rib	Frag	1.00	11.27	11.27	0.44	0.52
2742	Rib	Frag	1.00	3.89	3.89	0.44	0.18
2652	Innom	L	1.00	91.15	91.15	0.44	4.42
2734	Longbone	Frag	1.00	7.40	7.40	0.44	0.34
2737	Longbone	Frag	1.00	2.42	2.42	0.44	0.11
2648	Talus	R	1.00	64.27	64.27	0.44	2.99
2654	Talus	R	1.00	90.86	90.86	0.44	4.22
2655	Navicul	L	1.00	41.97	41.97	0.44	1.95
2653	Phalange	Third	1.00	18.13	18.13	0.44	0.84
2663	Unclass	Frag	4.00	2.34	0.59	1.78	0.11
3052	Unclass	Frag	112.00	43.54	0.39	49.78	2.02
2733	Unclass	Frag	6.00	0.81	0.14	2.67	0.04
2739	Unclass	Frag	37.00	5.96	0.16	16.44	0.28
2740	Unclass	Frag	4.00	0.69	0.17	1.78	0.03
2743	Unclass	Frag	11.00	16.42	1.49	4.89	0.76
	TOTAL		225.00	2152.20	9.57	100.00	100.00
						51.96	48.29
	GRAND TOTAL		433.00	4457.17	10.29	100.00	100.00

Figure 77. Units 7 and 20, level 8, Area 2.

Figure 78: Bone deposit, Units 7 and 20, level 8, Area 2.

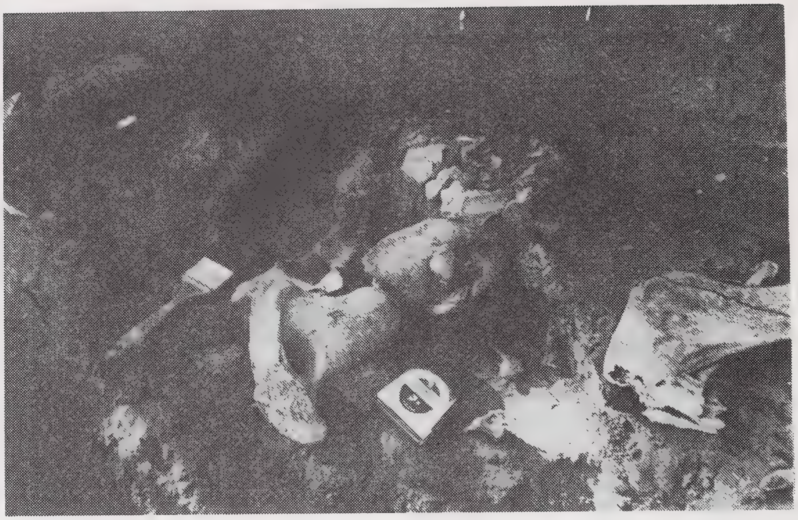


Figure 79: Close up of bone deposit, Unit 20, level 8, Area 2.

Figure 80: Close up of bone deposit, Unit 20, level 8, Area 2.

two bison are represented in this small sample (Table 31). In addition to bison remains, Level 8 yielded a Cervid-size long bone fragment (#2955), a rodent femur that probably represents a ground squirrel (#2669), and a Canid skull (#3051) (Figure 81). The Canid skull has been the subject of special study and appears to represent a dog/wolf hybrid (Morlan 1983)*

Comment: This is the only level of the test excavation for which adequate data demonstrate a primary occupation floor (see Brink and Morlan 1983). Future excavation should concentrate on this level in adjacent squares.

Level 9

Sediments: A gravelly sand layer containing sandstone fragments up to 3 cm across was removed as a natural level.

Fauna: Only a few of the 499 bone fragments could be mapped and only one exceeded 100 grams in weight (Table 32). All the largest pieces are isolated teeth, rib and long bone fragments, many of which are slightly rounded and show preferred orientation nearly parallel to the axis of the spring channel. The composition, rounding, and orientation of the

Figure 81: Canid Skull, Unit 7, level 8, Area 2.

* Note; after the completion of this report, Morlan says that subsequent analysis has revealed that this specimen is in fact an extremely large dog. J.B.

Table 32
Level 9 Bison, H.S.I. Spring Channel

Cat. No	Element	Side	Number	Weight	Mean Wt.	Percent Number	Percent Weight
UNIT 7							
2987	Maxilla	Frag	9.00	6.63	0.74	3.52	1.16
2980A	Corpus	Frag	1.00	4.32	4.32	0.39	00.76
2964	Up Premo	R2	1.00	12.16	12.16	0.39	2.14
2986	Up Premo	L2	1.00	1.43	1.43	0.39	0.25
2967	Up Premo	L3	1.00	11.73	11.73	0.39	2.06
2969	Incisor	L2	1.00	2.94	2.94	0.39	0.52
2962	Incisor	R3	1.00	2.02	2.02	0.39	0.35
2966	Incisor	R4	1.00	1.63	1.63	0.39	0.29
2963	Lo Molar	R2	1.00	23.46	23.46	0.39	4.12
2985	Cheek To	Frag	20.00	9.87	0.49	7.81	1.73
2977	Rib Head	L6	1.00	17.00	17.00	0.39	2.99
2988	Rib	Head	1.00	3.09	3.09	0.39	0.54
2987A	Rib	Head	1.00	1.00	1.00	0.39	0.18
2965	Rib	Frag	1.00	12.81	12.81	0.39	2.25
2968	Rib	Frag	1.00	19.78	19.78	0.39	3.47
2972	Rib	R6	1.00	124.78	124.78	0.39	21.92
2973	Rib	Frag	1.00	71.03	71.03	0.39	12.48
2974	Rib	Frag	1.00	29.30	29.30	0.39	5.15
2975	Rib	Frag	1.00	26.68	26.68	0.39	4.69
2976	Rib	Frag	1.00	8.30	8.30	0.39	1.46
2981	Rib	Frag	2.00	16.15	8.08	0.78	2.84
2981A	Rib	Frag	2.00	13.45	6.73	0.78	2.36
2961	Metacarp	L	1.00	10.52	10.52	0.39	1.85
2970	Longbone	Frag	1.00	31.72	31.72	0.39	5.57
2978	Longbone	Frag	1.00	9.06	9.06	0.39	1.59
2979	Unclass	Frag	143.00	38.58	0.27	55.86	6.78
2980	Unclass	Frag	20.00	39.01	1.95	7.81	6.85
2982	Unclass	Frag	39.00	20.86	0.53	15.23	3.66
	TOTAL		256.00	569.31	2.22	100.00	100.00
						51.30	66.71

Cat. No	Element	Side	Number	Weight	Mean Wt.	Percent Number	Percent Weight
UNIT 20							
2756	Cranial	Frag	1.00	0.87	0.87	0.41	0.31
2764	Cranial	Frag	7.00	2.48	0.35	2.88	0.87
2682	Meatus	L	1.00	47.59	47.59	0.41	16.75
2750A	Meatus	Frag	1.00	6.16	6.16	0.41	2.17

Table 32 (continued)

Cat. No	Element	Side	Number	Weight	Mean Wt.	Percent Number	Percent Weight
UNIT 20 (continued)							
2749	Lo Premo	L2	1.00	2.53	2.53	0.41	0.89
2751	Lo Premo	R2	1.00	1.23	1.23	0.41	0.43
2747	Cheek To	Frag	10.00	4.02	0.40	4.12	1.42
2763	Cheek To	Frag	4.00	0.04	0.01	1.65	0.01
2765	Cheek To	Frag	1.00	2.72	2.72	0.41	0.96
2758	Cervical	Transpine	1.00	1.91	1.91	0.41	0.67
2680	Lumbar	Transpine	1.00	13.18	13.18	0.41	4.64
2657	Rib	Head	1.00	15.74	15.74	0.41	5.54
2676	Rib	Frag	1.00	13.82	13.82	0.41	4.86
2748	Rib	Frag	1.00	0.64	0.64	0.41	0.23
2678	Rib	Frag	1.00	15.64	15.64	0.41	5.51
2755	Rib	Frag	1.00	27.55	27.55	0.41	9.70
2767	Scapula	R	1.00	10.51	10.51	0.41	3.70
2750	Scapula	Blade	1.00	1.46	1.46	0.41	0.51
2671	Longbone	Frag	1.00	3.10	3.10	0.41	1.09
2746	Longbone	Frag	11.00	18.20	1.65	4.53	6.41
2754	Longbone	Frag	6.00	12.11	2.02	2.47	4.26
2674	Phalange	First	1.00	6.89	6.89	0.41	2.43
2744	Unclass	Frag	17.00	4.42	0.26	7.00	1.56
2745	Unclass	Frag	61.00	19.39	0.32	25.10	6.83
1752	Unclass	Frag	7.00	1.57	0.22	2.88	0.55
2753	Unclass	Frag	25.00	8.23	0.33	10.29	2.90
2759	Unclass	Frag	60.00	15.35	0.26	24.69	5.40
2760	Unclass	Frag	7.00	2.35	0.34	2.88	0.83
2761	Unclass	Frag	4.00	9.57	2.39	1.65	3.37
2762	Unclass	Frag	1.00	3.22	3.22	0.41	1.13
2768	Unclass	Frag	6.00	11.59	1.93	2.47	4.08
	TOTAL		243.00	284.08	1.17	100.00 48.70	100.00 33.29
	GRAND TOTAL		499.00	853.39	1.71	100.00	100.00

assemblage suggest that it has undergone fluvial redeposition (Brink and Morlan 1983). Two rib fragments (#2965, 2976) are scratched on both faces, possibly due to redeposition in coarse sand, and they can be refitted end-to-end. Similar fine scratches are seen on a large rib (#29972) which also bears a cut near the break. Another cut rib fragment (#2975) was gnawed and then etched by rootlets after the butchering marks were made. Carnivore gnawing is also seen on two rib fragments (#2968, 29733) and a metacarpal fragment (#2961). All cut and gnawed elements are from Unit 7. Thirty-one fragments (6.2%), all from Unit 20, are charred. Non-bison elements include a Lagomorph phalange (#2983), a rodent lumbar vertebra (#2984), a Cervid rib fragment (#2673), a small mammal bone fragment (#2766), a fox canine tooth (#2971), and a fox (?) phalange (#2766A).

Level 10

Sediments: Arbitrary 10 cm level in dark brown silt. Silt is finely bedded with fine sand at top. Then becomes massive with increased clay below. The bedded portion is thicker in the eastern half of Unit 7 where it was not completely removed by this level. In the western half of Unit 7 Level 10 slightly penetrates the massive clayey silt. Several scattered rounded pebbles, including a 1 x 2 cm chert pebble, were noted in this level, and they are out-sized in this sediment.

Fauna: Only 17% of the 590 bone fragments occurred in Unit 7 where the largest specimen is a rib fragment that was found in the upper 2 cm of the level (Table 33). Several people worked on the excavation of Unit 10, and not all of them recorded notes. I am not certain that the Level 10 faunal remains in Unit 20 were adequately separated form those of Level 11, but the arbitrary nature of these levels means that my uncertainty may not be important. Loretta Rose recorded some important observations concerning bone orientation, noting that a bison calcaneus rested on its anterior end at an angle of 45-50 degrees from horizontal and lay atop a flat-lying rib fragment. Adjacent to the calcaneus was a long bone fragment resting on end. The calcaneus extended nearly 5 cm into Level 11, but it was bagged and catalogued as a specimen from Level 10 (#2659). A sketch map representing the composite results of several day's work by several excavators suggests a nearly circular concentration

Table 33
Level 10 Bison, H.S.I. Spring Channel

Cat. No	Element	Side	Number	Weight	Mean Wt.	Percent Number	Percent Weight
UNIT 7							
2997	Cranial	Frag	1.00	1.32	1.32	0.98	0.96
2999	Cranial	Frag	1.00	5.70	5.70	0.98	4.13
2992	Cheek To	Frag	3.00	0.84	0.28	2.94	0.61
2993	Cheek To	Frag	5.00	2.30	0.46	4.90	1.67
2989	Rib	Frag	1.00	55.65	55.65	0.98	40.33
2996	Rib	Frag	1.00	6.16	6.16	0.98	4.46
2998	Rib	Frag	1.00	2.41	2.41	0.98	1.75
2995A	Radius	L	1.00	17.78	17.78	0.98	12.88
2995	Longbone	Frag	1.00	8.74	8.74	0.98	6.33
2990	Unclass	Frag	12.00	4.99	0.42	11.76	3.62
2991	Unclass	Frag	1.00	2.42	2.42	0.98	1.75
2994	Unclass	Frag	74.00	29.68	0.40	72.55	21.51
	TOTAL		102.00	137.99	1.35	100.00	100.00
						17.29	17.68

Cat. No	Element	Side	Number	Weight	Mean Wt.	Percent Number	Percent Weight
UNIT 20							
2778	Skull	Frags	1.00	43.71	43.72	0.20	6.80
2672	Cranial	Frag	1.00	3.58	3.58	0.20	0.56
2774	Cranial	Frag	1.00	4.48	4.48	0.20	0.70
2788	Cranial	Frag	1.00	1.36	1.36	0.20	0.21
2789	Cranial	Frag	1.00	3.59	3.59	0.20	0.56
2797	Cranial	Frag	1.00	8.90	8.98	0.20	1.40
2800	Cranial	Frag	28.00	6.33	0.23	5.74	0.99
2803	Cranial	Frag	11.00	18.05	1.64	2.25	2.81
2863A	Malar	L	1.00	3.43	3.43	0.20	0.53
2687	Malar	L	1.00	9.27	9.27	0.20	1.44
2683	Maxilla	L	1.00	4.24	4.24	0.20	0.66
2785	Nasal	Frag	3.00	4.72	1.57	0.61	0.73
2784	Nasal	Frag	1.00	2.02	2.02	0.20	0.31
2796	Nasal	L	1.00	14.59	14.59	0.20	2.27
2783	Facial	Frag	1.00	1.11	1.11	0.20	0.17
2670	Up Molar	L3	1.00	43.36	43.36	0.20	6.75
2782	Up Molar	R2	1.00	22.11	22.11	0.20	3.44
2775	Up Molar	L U	1.00	17.76	17.76	0.20	2.76
2675	Incisor	R	1.00	1.98	1.98	0.20	0.31
2795	Lo Premo	R2	1.00	3.32	3.32	0.20	0.52

Table 33 (continued)

Cat. No	Element	Side	Number	Weight	Mean Wt.	Percent Number	Percent Weight
UNIT 20 (continued)							
2777	Cheek To	Frag	1.00	2.14	2.14	0.20	0.33
2779	Cheek To	Frag	1.00	1.36	1.36	0.20	0.21
2793	Cheek To	Frag	16.00	10.67	0.67	3.28	1.66
2799	Cervical R	Transpire	1.00	3.58	3.58	0.20	0.56
2681	Thoracic	Spine	1.00	10.50	10.50	0.20	1.63
2781	Intervert	Disk L4	1.00	6.83	6.83	0.20	1.06
2668	Intervert	Disk	1.00	11.83	11.83	0.20	1.84
2801A	Intervert	Disk	1.00	1.34	1.34	0.20	0.21
2798	Rib Head Epiphysis		1.00	1.80	1.80	0.20	0.28
2802	Rib Head Epiphysis		1.00	0.79	0.79	0.20	0.12
2662	Rib	Frag	1.00	12.39	12.39	0.20	1.93
2679	Rib	Frag	1.00	13.00	13.00	0.20	2.02
2684	Rib	Frag	1.00	13.61	13.61	0.20	2.12
2684A	Rib	Frag	1.00	6.55	6.55	0.20	1.02
2773	Rib	Frag	1.00	7.40	7.40	0.20	1.15
2780	Rib	Frag	2.00	7.00	3.50	0.41	1.09
2786	Rib	Head	1.00	12.11	12.11	0.20	1.88
2792	Rib	Frag	3.00	12.30	4.10	0.61	1.91
2792A	Rib	Frag	1.00	2.96	2.96	0.20	0.46
2665	Longbone	Frag	1.00	1.89	1.89	0.20	0.29
2666	Longbone	Frag	1.00	12.79	12.79	0.20	1.99
2772	Scaphoid	R	1.00	23.71	23.71	0.20	3.69
2659	Calcaneus	R	1.00	127.56	127.56	0.20	19.86
2661	Unclass	Frag	1.00	0.22	0.22	0.20	0.03
2769	Unclass	Frag	30.00	4.13	0.14	6.15	0.64
2770	Unclass	Frag	1.00	1.23	1.23	0.20	0.19
2790	Unclass	Frag	41.00	10.57	0.26	8.40	1.65
2791	Unclass	Frag	282.00	60.30	0.21	57.79	9.39
2794	Unclass	Frag	28.00	39.69	1.42	5.74	6.18
2801	Unclass	Frag	5.00	4.21	0.84	1.02	0.66
	TOTAL		488.00	642.45	1.32	100.00	100.00
						82.71	83.32
			590.00	780.44	1.32	100.00	100.00

of bone fragments in Unit 20. Only 44 bone fragments (7.5%) attributed to Level 10 are charred. Carnivore gnawing was noted on the tuber calcis of the calcaneus (#2659) and one two rib fragments (#2780, 2989). One upper RM2 is unworn and represents a very young bison. Non-bison elements include a rodent lumbar vertebra (#2771) and a possible bird bone (#2776).

Level 11

Sediments: Arbitrary 10 cm level through remainder of bedded silt and massive brown silt to a lighter gray-brown silt. Unit 20 was excavated after I left the field, and the notes record major finds but provided no observations on sediment characteristics.

Fauna: In contrast with Level 10, bone fragments were almost evenly distributed between the two units in Level 11 (Table 34). A few pieces were tapped in Unit 20, but they do not form a distribution worth redrawing for this report. A canid tibia resting at an angle of 45 degrees protruded into Level 11 but was removed and bagged as part of Level 12. Charring was observed on 53 (14.2%) of the bone fragments from Level 11. Non-bison elements include a small mammal rib (#3000) and a Canid lower right third premolar (#302).

Levels 12-14

Sediments: Arbitrary levels in light gray-brown silt, the lighter colour of which is due to a higher concentration of sandstone particles, in Level 12, then into dark brown silt in Level 13. Many sandstone clasts, some up to 3 cm long, were encountered in Level 12, and such clasts were up to 10 cm long in Level 13. Fine-grained material that I originally mistook for bone meal proved to be pulverized sandstone. A possible hearth in the southeast corner of Unit 7 proved to be merely a dark stain, but a concentration of charred bone fragments in the northeast corner of Unit 7, originally seen in Level 12, enlarged to a substantial ovate area in Level 13. At the time of my departure from the field, I had just begun to work on Level 14 in Unit 8. Levels 12-13 were not completed in Unit 20 until later when Loretta Rose and Maureen Rollans worked there. I have combined these levels here because I can

Table 34
Level 11 Bison, H.S.I. Spring Channel

Cat. No.	Element	Side	Number	Weight	Mean Wt.	Percent Number	Percent Weight
UNIT 7							
3007	Cheek To	Frag	3.00	1.88	0.63	1.47	1.89
3006	Rib	Frag	4.00	12.66	3.17	1.96	12.70
3008	Metapod	Frag	1.00	2.39	2.39	0.49	2.40
3008A	Talus	R	1.00	4.50	4.50	0.49	4.51
3001	T Cuneif	L	1.00	9.76	9.76	0.49	9.79
3003	Unclass	Frag	136.00	37.62	0.28	66.67	37.73
3004	Unclass	Frag	7.00	16.72	2.39	3.43	16.77
3005	Unclass	Frag	51.00	14.18	0.28	25.00	14.22
	TOTAL		204.00	99.71	0.49	100.00	100.00
						54.84	44.30
UNIT 20							
2804	Cranial	Frag	1.00	15.23	15.23	0.60	12.15
2812	Cranial	Frag	12.00	7.23	0.60	7.14	5.77
2806	Malar	L	1.00	58.93	58.93	0.60	47.00
2811	Cheek To	Frag	5.00	1.09	0.22	2.98	0.87
2807	Cartilage	Rib	1.00	0.94	0.94	0.60	0.75
2805	Rib	Head	1.00	2.48	2.48	0.60	1.98
2757	Sesamoid	Prox	1.00	5.75	5.75	0.60	4.59
2808	Unclass	Frag	40.00	6.99	0.17	23.81	5.57
2809	Unclass	Frag	105.00	26.53	0.25	62.50	21.16
2810	Unclass	Frag	1.00	0.22	0.22	0.60	0.28
	TOTAL		168.00	125.39	0.75	100.00	100.00
						45.16	55.70
	GRAND TOTAL		372.00	225.10	0.61	100.00	100.00

find in the notes no reason to separate them and several reasons for grouping them into a single unit.

Fauna: The faunal remains from Levels 12 and 13 are presented separately in Tables 35 and 36, but they probably represent samples of a single faunal asemblage. These two levels produced the largest faunal samples in the excavation, but my interpretation of them is hampered by my not having seen all specimens from Unit 20, Level 13. Of the material on hand, the combined samples from Levels 12 and 13 represent at least two bison on the basis of right scapulae. In Level 12 there 106 (27.7%) charred bone fragments and in Level 13 there are 299 (31.2%), reflecting the presence of the feature containing charred bones. In Level 12, only a Canid tibia (#2813) exhibits carnivore gnawing marks, and in Level 13 only one rib fragment (#3029) has been gnawed. A long bone fragment from Level 13 (#2929) was broken when fresh and exhibits a well preserved point of impact. One bison bone from Level 12, a right pisiform (#2821), is outstanding for its large size. The Level 14 fauna is known only from Unit 7 (Table 37) where 160 bone fragments include 365 (22.5%) charred specimens that may reflect the influence of the charred bone feature described above. The only large bone from Level 14 is a scapula.

Levels 15-16

I have not yet examined the bones from Milt Wright's excavation in Levels 15-16 of Unit 20. Judging from Wright's sketch of the bone distribution, the specimens either are in primary context or have been redeposited in a mudflow. The elements have not been sorted as sedimentary particles, and they exhibit no preferred orientation (Figures 82 & 83).

Summary

Even the limited test excavation of 1983 has shown that bones are not uniformly distributed either vertically or horizontally in the spring channel deposits. This fact alone suggests the promise of primary deposits that might be well separated from one another stratigraphically. The vertical distribution of bison remains is noted in Table 38. The primary deposit in the paleosol of Level 8 stands out prominently in the

Table 35

Level 12 Bison, H.S.I. Spring Channel

Cat. No.	Element	Side	Number	Weight	Mean Wt.	Percent Number	Percent Weight
UNIT 7							
3011	Occipcon	R	1.00	34.30	34.30	0.29	5.79
3021	Cranial	Frag	3.00	2.45	0.82	0.88	0.41
3009	Up Molar	L3	1.00	26.35	26.35	0.29	4.44
3017	Cheek To	Frag	6.00	2.12	0.35	1.77	0.36
3012	Rib	Frag	5.00	3.56	0.71	1.47	0.60
3018	Rib	Frag	3.00	4.23	1.41	0.88	0.71
3018A	Rib	Frag	1.00	3.51	3.51	0.29	0.59
3010	Scapula	R	1.00	375.01	375.01	0.29	63.25
3013	Unclass	frag	205.00	56.45	0.28	60.47	9.52
3014	Unclass	Frag	7.00	23.22	3.32	2.06	3.92
3015	Unclass	Frag	8.00	22.18	2.727	2.36	3.74
3016	Unclass	frag	92.00	29.32	0.32	27.14	4.95
3019	Unclass	frag	4.00	9.78	2.45	1.18	1.65
3020	Unclass	Frag	2.00	0.40	0.20	0.59	0.07
	TOTAL		339.00	592.88	1.75	100.00	100.00
						45.63	73.38
UNIT 20							
2823	Cranial	Frag	1.00	2.65	2.65	0.25	1.23
2830	Cranial	Frag	10.00	11.49	1.15	2.48	5.34
2824	Cheek To	Frag	1.00	0.18	0.18	0.25	0.08
2825	Cheek To	Frag	6.00	3.00	0.50	1.49	1.40
2815	Caudal	One	1.00	8.89	8.89	0.25	4.13
2832	Intervert	Disk	1.00	2.27	2.27	0.25	1.06
2832A	Intervert	Disk	1.00	1.83	1.83	0.25	0.85
2816	Rib	Frag	1.00	7.36	7.36	0.25	3.42
2820	Rib	Frag	3.00	5.52	1.84	0.74	2.57
2834	Rib	Frag	1.00	0.91	0.91	0.25	0.42
2817	Malleolus	R	1.00	7.10	7.10	0.25	3.30
2822	Longbone	Frag	4.00	8.06	2.02	0.99	3.75
2821	Pisiform	R	1.00	20.40	20.40	0.25	9.49
2814	Unclass	Frag	1.00	2.43	2.43	0.25	1.13
2818	Unclass	frag	254.00	61.73	0.24	62.87	28.71
2819	Unclass	frag	11.00	29.07	2.64	2.72	13.52
2831	Unclass	Frag	95.00	22.67	0.24	23.51	10.54
2833	Unclass	Frag	9.00	15.37	1.71	2.23	7.15
2835	Unclass	Frag	2.00	4.10	2.05	0.50	1.91
	TOTAL		404.00	215.03	0.53	100.00	100.00
						54.37	26.62
	GRAND TOTAL		743.00	807.91	1.09	100.00	100.00

Table 36
Level 13 Bison, H.S.I. Spring Channel

Cat. No.	Element	Side	Number	Weight	Mean Wt.	Percent Number	Percent Weight
UNIT 7							
3025	Occipcon	L	1.00	51.86	51.86	0.15	6.25
3032	Cranial	Frag	9.00	9.41	1.05	1.33	1.13
3037	Up Premo	R4	1.00	8.00	8.00	0.15	0.96
3038	Lo Premo	R4	1.00	4.09	4.09	0.15	0.49
3036	Cheek To	Frag	13.00	8.27	0.64	1.93	1.00
3039	Cheek To	Frag	5.00	0.95	0.19	0.74	0.11
3023	Cervical	Three	1.00	99.16	99.16	0.15	11.95
3040A	Thoracic	Prezyga	1.00	3.00	3.00	0.15	0.36
3041A	Vertebra	Centrum	1.00	10.10	10.10	0.15	1.22
3028	Intervert Disk	Thor	1.00	5.59	5.59	0.15	0.67
3022	Rib	Frag	1.00	6.72	6.72	0.15	0.81
3029	Rib	Frag	1.00	19.33	19.33	0.15	2.33
3034	Rib	Frag	1.00	4.23	4.23	0.15	0.51
3026	Scapula	R	1.00	205.35	205.35	0.15	24.74
3033	Longbone	Frag	1.00	20.12	20.12	0.15	2.42
3041	Longbone	Frag	1.00	11.88	11.88	0.15	1.43
3024	Talus?	Frag	1.00	8.20	8.20	0.15	0.99
3027	Sesamoid	Prox	1.00	3.65	3.65	0.15	0.44
3030	Unclass	Frag	410.00	169.07	0.41	60.74	20.37
3031	Unclass	Frag	201.00	105.01	0.52	29.78	12.65
3035	Unclass	Frag	14.00	57.60	4.11	2.07	6.94
3040	Unclass	Frag	8.00	18.43	2.30	1.19	2.22
	TOTAL		675.00	830.02	1.23	100.00	100.00
						70.53	82.82
UNIT 20							
2845	Cheek To	Frag	1.00	1.41	1.41	0.35	0.82
2826	Thoracic	Spine	1.00	30.38	30.38	0.35	17.65
2829	Intervert Disk	Cerv	1.00	4.62	4.62	0.35	2.68
2848	Intervert	Disk	1.00	0.26	0.26	0.35	0.15
2827	Rib	Frag	1.00	3.02	3.02	0.35	1.75
2844	Rib	Frag	4.00	3.45	0.86	1.42	2.00
2828	Longbone	Frag	1.00	19.02	19.02	0.35	11.05
2836	Unclass	Frag	1.00	3.86	3.86	0.35	2.24
2837	Unclass	Frag	42.00	19.62	0.47	14.89	11.40
2838	Unclass	Frag	11.00	1.09	0.10	3.90	0.63
3829	Unclass	Frag	16.00	3.32	0.21	5.67	1.93
2840	Unclass	Frag	2.00	14.64	7.32	0.71	8.50
2841	Unclass	Frag	12.00	21.90	1.83	4.26	12.72
2842	Unclass	Frag	114.00	28.70	0.25	40.43	16.67
2843	Unclass	Frag	71.00	14.83	0.21	25.18	8.61
2846	Unclass	Frag	1.00	0.15	0.15	0.35	0.09
2847	Unclass	Frag	2.00	1.89	0.95	0.71	1.10
	TOTAL		282.00	172.16	0.16	100.00	100.00
						29.47	17.18
	GRAND TOTAL		957.00	1002.18	1.05	100.00	100.00

Table 37
Level 14 Bison, H.S.I. Spring Channel

Cat. No.	Element	Side	Number	Weight	Mean Wt.	Percent Number	Percent Weight
UNIT 7							
3049	Cranial	Frag	8.00	15.09	1.89	5.00	2.73
3043	Intervert	Disk Thor	1.00	2.15	2.51	0.63	0.45
3045A	Intervert	Disk	1.00	0.52	0.52	0.63	0.09
3042	Scapula	R	1.00	429.28	429.28	0.63	77.65
3048A	Humerus	Dist. Frag	1.00	3.74	3.74	0.63	0.68
3044	Longbone	frag	1.00	26.03	26.03	0.63	4.71
3047	Longbone	Frag	3.00	16.84	5.61	1.88	3.05
3045	Unclass	Frag	107.00	41.45	0.39	66.88	7.50
3046	Unclass	Frag	35.00	11.04	0.32	21.88	2.00
3047A	Unclass	Frag	1.00	2.86	2.86	0.63	0.52
3048	Unclass	Frag	1.00	3.51	3.51	0.63	0.63
	TOTAL		160.00	552.87	3.46	100.00	100.00

Table 38
Summary of Bison, H.S.I. Spring Channel

	Number	Weight	Mean Wt.	Number %	Weight %
Level 1	5.00	37.53	7.51	0.09	0.35
Level 2	97.00	189.60	1.95	1.71	1.76
Level 3	281.00	627.15	2.23	4.94	5.84
Level 4	582.00	496.00	0.85	10.23	4.62
Level 5	538.00	482.63	0.90	9.46	4.49
Level 6	498.00	686.56	1.38	8.76	6.39
Level 7	92.00	99.50	1.08	1.62	0.93
Level 8	433.00	4457.17	10.29	7.61	41.48
Level 9	499.00	853.39	1.71	8.77	7.94
Level 10	590.00	780.44	1.32	10.37	7.26
Level 11	372.00	225.10	0.61	6.54	2.09
Level 12	743.00	807.91	1.09	13.06	7.52
Level 13	957.00	1002.18	1.05	16.83	9.33
TOTAL	5687.00	10745.16	1.89	100.00	100.00
(UNIT 7 ONLY)					
Level 14	160.00	552.87	3.46		

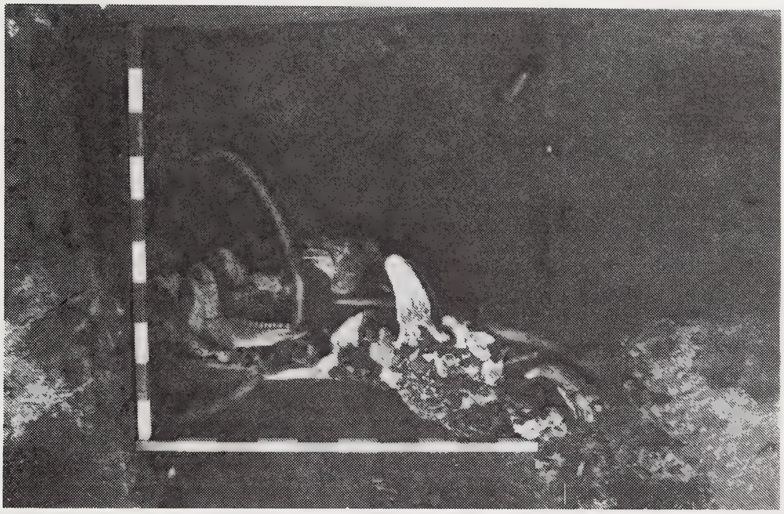


Figure 82: Bone deposit, Unit 20, level 16, Area 2.

Figure 83: Detail of bone deposit, Unit 20, level 16, Area 2.

percent by weight distribution, and Level 13 would have significantly higher peak if all recovered bones were included in the data. The Level 3 data are known to be conservative because large bone fragments were visible in the walls of both Units 7 and 20 (Figures 84 & 85). I expect all three of these levels to produce substantial primary components during the future excavations.

The distribution of charred bone fragments is shown in Table 39. Most charred specimens are tiny fragments averaging less than a gram in weight, and these can be abundant in redeposited assemblages due to their lower density and enhanced hardness (e.g., Level 7). In Level 8 there are two scorched large specimens, and the high frequencies of charring Levels 12-13 reflect the presence of a feature filled with charred bone.

Non-bison elements are listed in Table 40 to emphasize the potential for defining local faunas at H.S.I. Nearly all these specimens required further work to refine their taxonomic affiliations, but such time-consuming studies should await large samples.

Recommendations for the Future

A radiocarbon date of 1660 B.P. on bone collagen from Level 16, 160 cm B.S., suggests an average sedimentation rate of 10 cm/century in the HSI spring channel. The discovery of primary deposits in such a sedimentary environment is unprecedented at High Plains buffalo jump sites and is in marked contrast to the compressed stratigraphic record of the general prairie level at HSI. Full advantage should be taken of the opportunity to document single component occupations in secure stratigraphic contexts.

Future excavation should probe deeper and should be extended upslope from the 1983 test units. The entire trench depicted in Figure 21 should be excavated as deeply as possible, and the bone bed exposed in Levels 15 and 16 should be removed in order to seek older deposits. While both of these objectives are important, I recommend favouring the lateral extension of the excavation, because it is critical to understand the "attitudes" of the sedimentary layers in three dimensions. There must exist a buried lateral wall beyond which there are not spring channel deposits, and it is important to document the nature of the contacts between the spring channel sediments and adjacent rocks.

Table 39
Distribution of charred bone fragments in the H.S.I. Spring Channel

LEVEL	Total Number	Number Charred	Percent Charred	Mean Wt. Charred
1	5	0		
2	97	4	4.1	0.66
3	281	23	8.2	0.74
4	582	58	10.0	0.65
5	538	105	19.5	0.55
6	498	38	7.6	0.81
7	92	16	17.4	0.53
8	433	35	8.1	0.28(+2=120.6)
9	499	31	6.2	0.27
10	590	44	7.5	0.30
11	372	53	14.0	0.40
12	743	206	27.7	0.42
13	957	299	31.2	0.50
14	160	36	22.5	0.41

Table 40
Non-Bison remains from the H.S.I. Spring Channel

Level	Unit	Cat. No.	Taxon	Element	Weight
5	20	2715A	Small mammal	Fragment	0.36
8	7	2955	Artiodactyla	Long bone	9.55
8	7	3051	Canid	Skull	358.09
8	20	2669	Rodent	Femur	0.73
9	7	2971	Fox	Canine	0.58
9	7	2983	Lagomorpha	Phalange	0.10
9	7	2984	Rodent	Lumbar vert.	0.10
9	20	2673	Cervidae	Rib	6.08
9	20	2766	Small mammal	Fragment	0.06
9	20	2766A	Fox?	Phalange	0.27
10	20	2711	Rodent	Lumber vert.	0.10
10	20	2776	Bird?	Fragment	0.03
11	7	3000	Small mammal	Rib	1.69
11	7	3002	Canid	Lower Rp3	1.68
12	20	2813	Canid	R. tibia	59.33

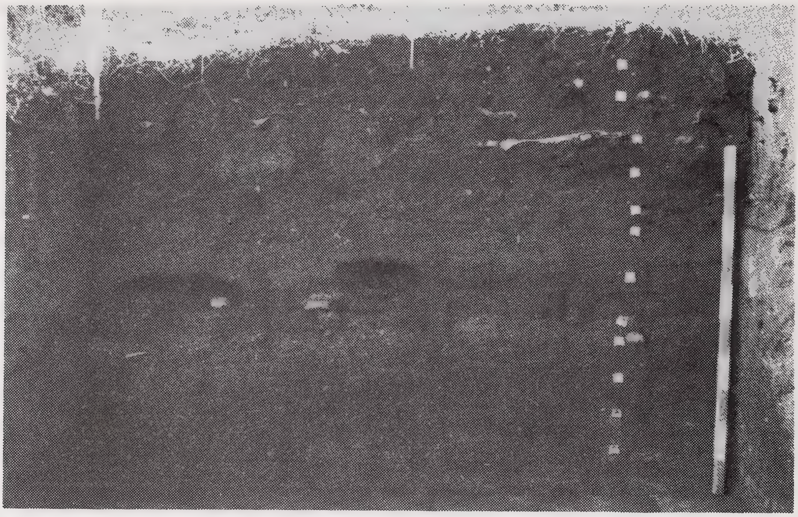


Figure 84: Profile of Units 7 and 20, Area 2.

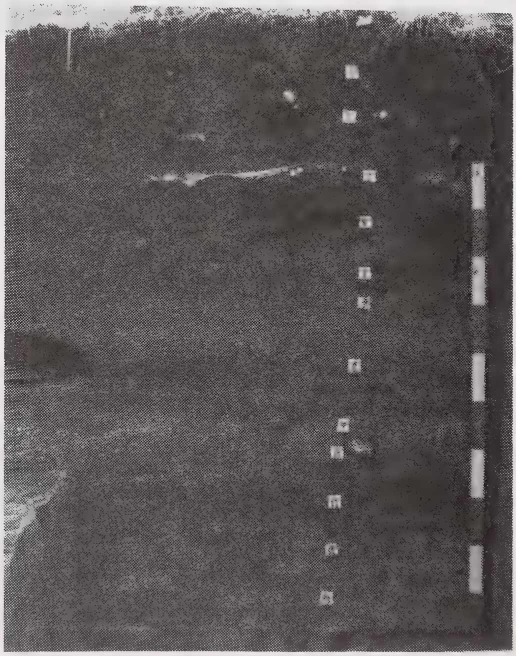


Figure 85: Profile of Unit 7, Area 2 (Note level tags).

A good reason for probing deeper is to rescue bone-rich deposits from the trampling of cattle during the winter season. In 1983 we defined a "bovipacted" crust up to 20 cm thick on the floor of the spring channel, and any bones left in place that near the surface could be extensively damaged by trampling.

In any future excavation, plans should be made for detailed stratigraphic studies including particle analysis, loss on ignition, clay mineralogy, and microfossil content. The data gathered in 1983 show that variations in the concentrations and sizes of faunal remains are not always in keeping with changes in sediment particle sizes, but these relationships must be quantified before they can contribute fully to taphonomic reconstructions.

It is still to be hoped that the "Archaeological Data Acquisition System" will be ready for field-testing in 1984, and the HSI spring channel would provide an ideal setting for such a test. The system will consist of a configuration of sensors through which grid coordinates can be delivered electronically to an on-site microcomputer, and it will provide automation not only of provenience data acquisition but also of an excavation catalogue. Current plans call for a demonstration of the system at the 1984 meeting of the Canadian Archaeological Association in Victoria.

APPENDIX 2

LITHIC ANALYSIS

METHODOLOGY

APPENDIX 2

LITHIC ANALYSIS METHODOLOGY

Classification: All lithic material was initially sorted into two groups: the flaked stone assemblage and the ground stone and unmodified stone tool assemblage. As relatively few ground stone artifacts were recovered, these were described individually using standard morphological-functional categories such as Hammerstones, Grooved Mauls, and Anvils.

To facilitate analysis of the flaked stone assemblage a classification system was devised. In an attempt to avoid some of the classification problems which stem from mixing technological, morphological, and stylistic criteria, a twofold classification scheme was used. The first sorting of artifacts was into classes of artifacts which shared the same level of technological development. Artifacts were then subdivided into analytical categories based on shared morphological or functional attributes. The flaked stone assemblage was initially subdivided into two gross groups: the detrital byproducts of stone tool manufacture including debitage and cores; and the products of stone tool manufacture including utilized flakes and fashioned tools. From these, five developmental classes were distinguished:

1. Debitage: includes flakes, shatter, and fragments thereof, which have not been used or further modified.
2. Cores: the object pieces of rock from which flakes were derived for the production of stone tools.
3. Marginally Retouched/Utilized Flakes: items of debitage which have been utilized or minimally modified. Retouch is restricted to the margins and does not alter the morphology of more than 50% of either face.
4. Unifaces: lithics which have been retouched on only one face to produce one or more useable edges. Retouch modifies more than 50% of one face.
5. Bifaces: lithics which have been retouched onto both faces to produce one or more useable edges. Retouch modifies more than 50% of one face.

Cores and tools were further subdivided into analytical categories. For the purposes of this report, debitage was analyzed indiscriminantly and not "typed". Cores were subdivided as follows:

Bipolar Cores: These are pieces of stone which have been impacted on one end while the other end is supported on an anvil. This is the most common technique of "getting into" pebbles and small cobbles, and hence bipolar cores and their byproducts often retain a smooth cortical surface. Bipolar cores characteristically have longitudinally trending flake removals often extending the length of the artifact, and several of these may radiate from one or both ends.

Simple Single Platform Cobble or Pebble Cores: These have been percussion flaked using a single platform surface and a single orientation for flake detachments. The initial primary flake removed would by definition be a spall, and subsequent byproducts have cortex platforms and often a cortical surface on the dorsal face.

Amorphous Multiple Platform Cores: These have two or more platforms, two or more flake detachment orientations, and more than one mode of reduction may be evident. Cortex can be completely removed and the platform and dorsal characteristics of derived byproducts can be highly variable. Other potential core types obviously exist, such as prepared polyhedral, conical, or microblade cores, but these have not been recovered or recognized in the assemblage.

Analytical categories of the three developmental classes of tools were standardized, as the criteria for distinguishing morphological and functional types can be satisfied at different levels of technological development. A desired projectile point form, for example, can often be achieved by marginally retouching a flake which has an inherently suitable configuration. In many instances, however, the desired form could only be achieved by extensively altering the blank, often completely removing the original surface.

The following tool categories were identified as having shared morphological and/or functional attributes:

1. Projectile Points
2. Hafted Bifaces
3. Hafted Spokeshaves/Gravers
4. Flake Knives
5. Flake Butt Drills
6. Awls

7. Pièces Esquillées
8. Endscrapers
9. Reamers
10. Large Sidescrapers
11. Large Bifacial Cutting/Scraping Tools

Tools which did not fit readily into the tool types listed above were lumped into catchall categories based on the number of use edges and the method of obtaining the edge morphology. These groups are as follows:

12. Single Utilized Edge Flakes
13. Single Unifacially Retouched Edge Flakes
14. Single Bifacially Retouched Edge Flakes
15. Multiple Retouched and/or Utilized Edge Tools

It should be noted that several of these latter categories are generalized constructs conveying little typological identity and are simply morphological divisions. Not all artifacts could be neatly pigeon-holed into typological categories. The typological categories employed here are abstractions based on shared sets of attributes, but are not necessarily culturally meaningful types. A multicomponent lithic assemblage is a dynamic entity where artifacts can be used and discarded, and picked up at a later date for reuse. Such reuse may involve an expedient usage of a tool or fragment in its existing form, or it might involve reworking a tool and partly altering its morphology. The reuse of a tool in such an expedient fashion need not relate to the design for which the tool was originally crafted. At Head-Smashed-In, where naturally occuring fine siliceous materials are rare, there can be little doubt that when the opportunity presented itself, "quarrying" of exposed previously discarded cultural materials would occur. It therefore follows that the artifact types described herein do not always correspond to the intended type configuration of the original craftsman, and may be typological bastards rather than culturally sensitive and meaningful types.

Having established an identity for each artifact, a computer compatible catalogue of basic provenience and classification information was compiled. This format was designed to be entered on assembler coding forms having 80 vertical columns and 24 horizontal lines a page. The format for recording this information is as follows:

COLUMN NO.	ATTRIBUTE NAME	DESCRIPTION
1 to 7	CATALOGUE NUMBER	The individual artifact catalogue number (not including the Borden designation).
8, 9	AREA	Areal designation of the site sub-area or locality from which the artifact was recovered.
10 to 12	UNIT	Individual unit designation usually numbered in the sequence of excavation, except for cases of auger or shovel tests, which were designated with a "7" or a "5" prefix in the tenth column respectively. Surface materials were given a unit designation of "999". Units are areally discrete.
13	QUADRANT	Each unit was subdivided into four quadrants numbered 1 to 4 clockwise from the southwest position.
14	SUBQUADRANT	Each quadrant was subdivided into four subquadrants numbered 1 to 4 as above. Column samples were designated as subquadrant "9".
15 to 17	POSITION NORTH	The position of the artifact in centimetres north of the south wall of the unit.
18 to 20	POSITION WEST	The position of the artifact in centimetres west of the east wall of the unit.
21, 22	LEVEL	Level designation of the artifact, either arbitrary or natural, numbered from the surface.
23 to 25	DEPTH	Depth in centimetres from surface or from datum.
26	SUBFILE	For all lithics a "1" is entered in this column.
27	CLASS	The developmental stage (numbers 1 to 5) as described previously.
28, 29	CATEGORY	The analytical tool category (number 1 to 15 described previously.

30, 31	RAW MATERIAL	The basic lithology of the constituent material of the artifact. These are detailed below.
32, 33	SOURCE/VARIETY	The particular type of raw material if the source is known.

A wide variety of lithic raw material types were recognized in the assemblage. As the people that undertook this analysis have variable expertise, and none are petrographers, raw material identification was based on hardness and visual characteristics of texture, color, and diaphaneity. Most of these types are gross categories except for a few peculiar varieties which were readily identifiable. Potential confusion regarding the discrimination of the multitude of "cryptocrystalline" silicates such as chert, agate, chalcedony, jasper, and flint, was avoided by lumping these into two categories only; chert was used to refer to all opaque microcrystalline silicates and chalcedony was used to refer to all translucent microcrystalline silicates. Where specific sources could be identified, such as Knife River Flint (a chalcedony here) these were assigned a numerical value and entered in the source variety columns (column no.'s 32 and 33) in the computer catalogue. Sources or varieties were rarely entered, however, often due to a lack of conviction in visually identifying these. Although a fairly extensive comparative collection of raw materials from known quarries in Montana and Alberta was available, this only served to cast doubt on the ability to reliably visually distinguish raw materials from discrete sources. The gross and raw material types and their codes used area as follows:

CODE	RAW MATERIAL
1	Chert
2	Chalcedony
3	Quartzite
4	Obsidian
5	Petrified Wood
6	Siliceous Siltstone
7	Siliceous Mudstone
8	Silicified Sandstone
9	Sandstone

10	Quartz
11	Basalt
12	Argillite
13	Limestone
14	Siltstone
15	Fused Glass
16	Porcellanite
17	Silicified Peat
18	Mudstone
19	Unidentified Fine Grained
20	Unidentified Coarse Grained

Analysis: A procedure of analysis was developed to help minimize "idiosyncratic data drift" which invariably occurs when an assemblage is analyzed by a number of people with divergent opinions and varying amounts of hands-on experience. The analytical component - the metric determinations and non-metric observations - was coded into a computer compatible format similar to the catalogue component, using assembler coding forms to record the information. To achieve the ideals of objectivity and duplication of results, metric attributes were kept to a minimum and non-metric attributes were normally restricted to ten variables. Lineal measurements were obtained with the use of sliding calipers. Weights were obtained either with an electronic balance or with a triple beam balance, and in all cases weights were rounded off to the nearest 0.1 grams. Angles were obtained using a swing arm contact goniometer, and all angles were rounded off to the nearest five degrees. Analytical procedures were different for debitage, cores, and tools. Projectile points were more exhaustively analyzed than other tools as they are recognized as being particularly sensitive cultural and temporal indices. The analysis applied to other tools, however, was standardized, as many marginally retouched tools, unifaces, and bifaces are regarded as developmental expressions representing different means to the same end. In some instances attributes were added to the standardized list to accommodate peculiar attributes such as the bits on drills. The analytical procedures and variable coding for the different analytical groupings of flaked stone tools are presented below.

DEBITAGE ANALYSIS

Three attributes were recorded for debitage. As this information was minimal it was recorded on the same coding forms as were used for the catalogue information, hence column numbers follow those given for raw material source or variety.

COLUMN NO.	ATTRIBUTE NAME	DESCRIPTION
34 to 38	WEIGHT	Debitage was weighed to the nearest 0.1 grams. Items which weighed less than 0.05 grams were recorded as having a weight of 0.0 grams.
29 to 41	SIZE	Flakes were sorted into gross size categories by use of a tray marked on the bottom with "size squares". The smallest square in the corner of the tray measures 5 mm a side and sizes are outlined in increasing 5 mm graduations. The flake or piece of shatter was laid in the corner of the tray touching the two sides which formed the common walls of the size squares, with the "Z" axis of the artifact approximately perpendicular to the base of the tray. The size was then recorded as the smallest square in which the artifact would fit. A flake fitting into a square measuring 25 mm a side (the "X" axis normally diagonally oriented on the square) would thus be recorded as having a size of "25".
42	CORTEX	This was recorded as simply being present (1) or absent (0).

CORE ANALYSIS

Each core was initially measured and its overall morphology was analyzed. Where possible it was subdivided into constituent analytical units for further analysis. As many platforms can occur on one core, each platform with its associated attributes is regarded as a separate analytical unit. Where it is possible to determine the last platform used in the reduction sequence this is the first platform analyzed and the analysis of platforms is in the reverse order in the sequence, otherwise platform designations are arbitrarily assigned.

COLUMN NO.	ATTRIBUTE NAME	DESCRIPTION
1 to 7	CATALOGUE NUMBER	The individual artifact catalogue number (not including the Borden designation.)
8 to 12	WEIGHT	Measured to the nearest 0.1 grams.
13 to 15	LENGTH	Measured as the longest lineal distance obtained between two points on the core (the "x" axis) to the nearest mm.
16 to 18	WIDTH	Measured as the longest distance between two points on the core obtained perpendicular to the x axis, to the nearest mm.
19 to 21	THICKNESS	The longest measurement obtained perpendicular to both the x and y axes, to the nearest mm.
22	NUMBER OF PLATFORMS	The count of discrete platforms from which flakes were removed (for bipolar cores only one platform was recorded for each axis of percussion). A discrete platform is defined here as a common surface from which flakes were struck in the same direction. 0 - indeterminate 1 - one platform 2 - two platforms 3 - three platforms 4 - four platforms 5 - five or more platforms
23	CORTEX	0 - no cortex 1 - 1 to 24% cortex cover 2 - 25 to 49% cortex cover 3 - 50 to 74% cortex cover 4 - 75 to 99% cortex cover 9 - indeterminate

24	SECONDARY FUNCTION	Use wear on cores was recorded. When cores have been modified by retouch, however, they were classified as tools. 0 - no use wear apparent. 1 - anvil 2 - hammerstone 3 - edge crushing 4 - edge smoothening or rounding 5 - edge nibbling 6 - edge nibbling and rounding 9 - multiple secondary functions
25	INTEGRITY	0 - indeterminate 1 - "complete" 2 - firebroken 3 - other post depositional fractures
26	HEAT ALTERATION	This is not necessarily an indication of purposeful thermal pretreatment but represents evidence of a thermally induced alteration whether intentional or spontaneous. 0 - none apparent 1 - discoloration attributed to heat 2 - lustre attributed to heat 3 - color and lustre attributed to heat 4 - potlidding 5 - multiple heat alteration effects 6 - firebroken with crenelated or spall type fractures 9 - indeterminate
27	PLATFORM 1 TYPE	1 - cortex surface 2 - single faceted surface 3 - faceted surface 4 - bedding, cleavage, or jointing plane 5 - faceted surface with cortex 6 - bipolar ridge or "arete" 9 - indeterminate
28 to 30	PLATFORM 1 ANGLE	An average measure at the locus or loci of applied force of the angle formed between the platform and the negative flake scar(s) to the nearest five degrees. For bipolar cores where this angle was not measurable the angle was estimated as ninety degrees.

31	NUMBER OF SCARS	This refers to the number of flake scars which are associated with the platform. For bipolar cores this would include flake scars derived from both ends. 1 - one flake scar 2 - two 3 - three 4 - four 5 - five or more 9 - indeterminate
32 to 34	FLAKE SCAR LENGTH	The length of the longest flake scar associated with the platform to the nearest mm
35	PLATFORM 1 PREPARATION	0 - none apparent 1 - grinding on platform edge 2 - microflaking extends onto flaked face from platform 3 - flaking extends toward the dorsal side from the platform-ventral face juncture.
36, 45, 54 ...	PLATFORM (n) TYPE	See Platform 1 Type for codes
37 to 39, 46 to 48, 55 to 57...	PLATFORM (n) ANGLE	See Platform 1 Angle for codes
40, 49, 58...	NUMBER OF SCARS	See Number of Scars above for codes
41 to 43, 50 to 52, 59 to 61...	FLAKE SCAR LENGTH	See Flake Scar Length above for method
44, 53, 62...	PLATFORM (n) PREPARATION	See Platform 1 Preparation for codes

FLAKED STONE TOOLS

All categories of marginally retouched or utilized lithics, unifaces, and bifaces, excepting projectile points, were minimally analyzed using a standard set of attributes. The majority of the tools in the assemblage could be satisfactorily analyzed using the following methodology and no further examination was deemed necessary. A few artifact catagories represented anomalous combined sets of attributes which were not sufficiently defined by the parameters outlined below. As these artifacts represented a small fraction of the total tool assemblage, a separate methodology was not devised for each, but where peculiarities did occur these were detailed in the results.

To enable a means of readily comparing salient morphological and functional attributes to facilitate both description and interpretation, each tool was analyzed by its discrete functional components or "functional units" (F.U.s). An F.U. is either a utilized portion of a tool or is a portion of a tool designed to perform a particular function. An F.U. is delimited by

a. a juncture or discontinuity on either extreme; or
b. it consists of such a juncture.

After a preliminary overall description of the tool was accomplished, each constituent F.U. was arbitrarily assigned a unit number and an analysis of each was undertaken. Although a plethora of difficulties were encountered and shortcomings were recognized, this method was found to be particularly useful in facilitating comparison of edge morphologies and use wear.

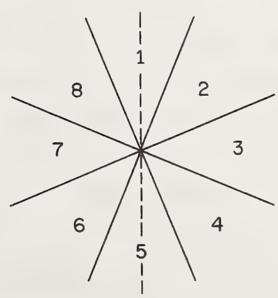
All lineal measurements were taken to the nearest 0.1 mm, weights were rounded off to the nearest 0.1 grams, and angles were averaged to the nearest five degrees.

COLUMN NO.	ATTRIBUTE	CODE OR DESCRIPTION
1 to 7	CATALOGUE NUMBER	The individual artifact number not including the Borden designation.
8 to 12	WEIGHT	Measured to the nearest 0.1 grams.
13 to 16	LENGTH	The maximum lineal dimension between any two points on the artifact (the "x" axis).
17 to 20	WIDTH	The maximum lineal dimension obtained between any two points on the artifact at right angles to the axis defining length above (the "y" axis).
21 to 23	THICKNESS	The maximum lineal dimension obtained between any two points on the artifact at right angles to a plane defined by the "x" and "y" axes above (the "z" axis).

CODE KEY: MARGINALLY RETOUCHED/UTILIZED LITHICS

COLUMN NO.(S)	ATTRIBUTE	CODE, VARIABLE
24	BLANK TYPE	0 - indeterminate 1 - flake 2 - shatter 3 - cortical spall or decortication flake 4 - bipolar split pebble fragment 5 - pebble/cobble 6 - tabular slab (i.e. bedrock slab)
25	PLANFORM	0 - indeterminate/irregular 1 - round 2 - oval/ovoid 3 - ovate 4 - triangular/trianguloid 5 - rectangular/rectanguloid 6 - quadrilateral 7 - bipointed 8 - semicircular/crescentic 9 - pentagonal
26	LONGITUDINAL X SEC.	0 - indeterminate/incomplete 1 - biconvex/lenticular 2 - biplanar 3 - plano-convex 4 - concavo-convex/concavo-triangular 5 - convexo-triangular 6 - plano-triangular 7 - diamond 8 - wedge-shaped 9 - other/irregular
27	TRANSVERSE X SEC.	same codes as above
28	HEAT ALTERATION	0 - none apparent 1 - discoloration attributed to heat 2 - lustre attributed to heat 3 - color and lustre attributed to heat 4 - potlidded 5 - firebroken 6 - crazed 7 - multiple heat effects 9 - indeterminate

29	INTEGRITY	0 - complete 1 - incomplete, indeterminate orientation 2 - firebroken 3 - largely complete, missing one of below 4 - distal end 5 - midsection 6 - edge segment 7 - proximal end 8 - edge juncture/corner 9 - end or half, indeterminate orientation.
30	NO. OF F.U.s	0 - indeterminate 1 - one 2 - two etc. 9 - nine or more
31, 41, 51..	F.U. (n) MORPHOLOGY	0 - indeterminate/incomplete 1 - straight 2 - convex 3 - concave 4 - sinuous 5 - serrated 6 - angular-acute 7 - angular-obtuse 8 - 9 - irregular/other
32, 42, 52..	F.U.(n) POINT OF ORIGIN (Counterclockwise)	The artifact is oriented witn the longitudinal axis parallel to the vertical dashed axis below witn the point defined by bisecting the artifact longitudinally and transversely placed on the midpoint below.



9 - functional unit extends around 360° of periphery

33,43,53..	F.U. (n) POINT OF TERMINATION (Clockwise)	Same codes as above
34, 44, 54..	ORIENTATION OF F.U. (n) RELATIVE TO LONGITUDINAL AXIS	0 - indeterminate 1 - transverse 2 - oblique 3 - parallel 4 - distal/proximal 5 - lateral 6 - transverse-oblique 7 - oblique-parallel 8 - transverse-oblique-parallel 9 - most/all periphery
35, 45, 55..	POSITION OF F.U. (n) ON FLAKE	0 - indeterminate/not applicable 1 - distal 2 - lateral 3 - proximal 4 - distal and lateral 5 - distal and bilateral 6 - proximal and lateral 7 - proximal and bilateral 8 - all edges 9 - proximal, lateral, and distal
36, 46, 56..	RETOUCH CHARACTERISTICS	0 - no retouch 1 - unifacial retouch 2 - bifacial retouch, even profile 3 - bifacial retouch, sinuous profile 4 - alternate unifacial retouch, even profile 5 - alternate unifacial retouch, sinuous profile 6 - alternate unifacial/bifacial, even profile 7 - alternate unifacial/bifacial, sinuous profile 8 - other/irregular 9 - indeterminate
37, 47, 57..	WEAR TYPE	0 - none apparent, indeterminate 1 - rounding 2 - rounding and polish 3 - nibbling and/or microflaking 4 - rounding and microflaking 5 - crushing 6 - transverse striations, rounding

		7 - longitudinal striations, rounding 8 - microflaking and ventral scarring 9 - other
38-40, 48-50, 58-60...	EDGE ANGLES	- average to nearest 5^{0}

PROJECTILE POINT ANALYSIS

All projectile points were measured for length, width, and thickness, and all were weighed. Other values were not obtained unless the attribute being measured was complete. No metric values were extrapolated, nor were morphological attributes projected. All lineal measurements were rounded off to the nearest 0.1 mm. Weights were rounded off to the nearest 0.1 grams. Angles were rounded off to five degrees and the angles expressed for edge angles are mean angles.

For convenience in rapidly accessing projectile point data a special projectile point data form was devised (Fig. 86). Spaces on this data sheet allotted to each measured digit or attribute code correspond to one column entry on the assembler coding forms to which this data was ultimately transferred. A space on this data sheet was provided for a xerox or photograph of the artifact for handy reference.

To facilitate description, projectile points were oriented with the distal tip up and proximal end or base down. The face bearing the catalogue number is termed the "obverse face" and the face without is termed the "reverse face". Where the catalogue number is on an interfacial surface the "faces" were arbitrarily assigned. When viewed looking at the obverse face the left side is referred to as side "1" for referring to a particular notch or blade edge for example, and the right side is referred to as side "2".

COLUMN NUMBER	ATTRIBUTE	CODE DESCRIPTION
1 to 7	CATALOGUE NUMBER	Individual artifact number (not including Borden designation).

CATALOGUE NUMBER:	16550
AREA:	2
UNIT:	4
QUADRANT; SUBQUAD.:	3.2
POSITION NORTH; WEST:	
LEVEL:	1
DEPTH:	
SUBFILE; CLASS:	1.5
CATEGORY:	1
RAW MATERIAL:	2
SOURCE/VARIETY:	

PROJECTILE POINT TYPE: AVONLEA: Timber Ridge
RAW MATERIAL, COLOR: CHALCEDONY, Beige
DATE RECOVERED: SEPTEMBER 12, 1983

PROJECTILE POINT TYPE:	2	INTEGRITY:	2
VARIETY:	1	LONG. X SEC.:	1
WEIGHT:	.4	TRANS. X SEC.:	1
MAXIMUM LENGTH:	15.9	BLANK TYPE:	0
MAXIMUM WIDTH:	11.4	BLANK ORIENTATION:	0
POS. MAX. WIDTH:	0.8	FLAKING TYPE OBVERSE:	1
MAXIMUM THICKNESS:	2.4	FLAKING PATTERN OBVERSE:	4
POS. MAX. THICKNESS:	1.5	FLAKING TYPE REVERSE:	5
BLADE LENGTH:		FLAKING PATTERN REVERSE:	2
STEM LENGTH:	4.3	BLADE EDGE 1 SHAPE:	1
BLADE WIDTH:	10.3	BLADE EDGE 1 MORPHOLOGY:	1
SHOULDER WIDTH:	10.3	BLADE EDGE 2 SHAPE:	1
POS. SHOULDER WIDTH:	4.6	BLADE EDGE 2 MORPHOLOGY:	1
NECK WIDTH:	8.1	SHOULDER 1 SHAPE:	1
POS. NECK:	3.4	SHOULDER 2 SHAPE:	1
STEM WIDTH:	11.4	EDGE GRINDING:	9
BASE WIDTH:	11.1	BASE SHAPE:	3
BASAL NOTCH DEPTH:	.8	BASAL THINNING:	5
NOTCH 1 DEPTH:	1.3	NOTCH 1 SHAPE:	5
NOTCH 1 BREADTH:	2.4	NOTCH 1 ORIENTATION:	1
NOTCH 2 DEPTH:	1.6	NOTCH 2 SHAPE:	7
NOTCH 2 BREADTH:	2.1	NOTCH 2 ORIENTATION:	1
PROX.-LAT. EDGE 1 HT.:	2.0	NOTCHING TECHNIQUE:	2
PROX.-LAT. EDGE 2 HT.:	2.0	PROX.-LAT. EDGE 1:	2
TIP ANGLE:		PROX.-LAT. EDGE 2:	2
BLADE ANGLE:	35	TIP MORPHOLOGY:	4
STEM ANGLE:		WEAR TYPE:	0
EDGE 1 ANGLE:	55	WEAR LOCATION:	0
EDGE 2 ANGLE:	50	HEAT TREATMENT:	0

Figure 86: Projectile Point Data Form.

8, 9 PROJECTILE POINT TYPE

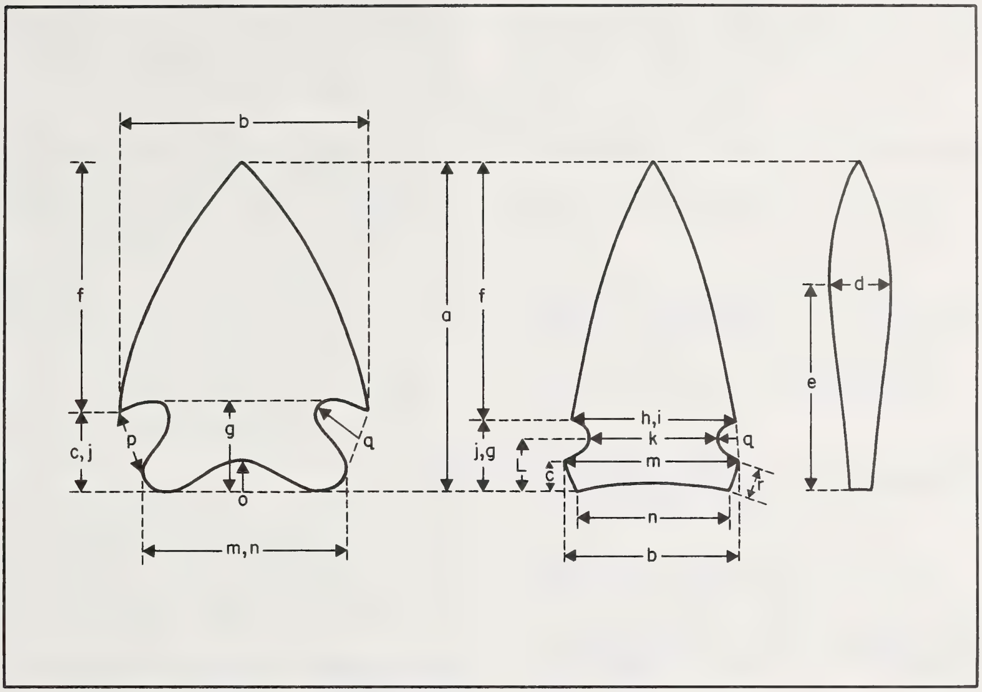
00 - indeterminate fragment
01 - Old Women's
02 - Avonlea
03 - Besant
04 - Pelican Lake
05 - Hanna
06 - Duncan (not used)
07 - McKean (not used)
08 - Oxbow (not used)
09 - Bitterroot (not used)
10 - Scottsbluff (not used)
11 - Triangular
12 - Unidentified Corner Notched
13 - Unidentified Side Notched
14 - Unidentified Side and Corner Notched
15 - Stemmed
16 - Unnotched, Eared
17 - Northern Side Notched
18 - Unidentified Ovate
19 - Unidentified Notched
20 - Lanceolate

10, 11 PROJECTILE POINT VARIETY

01 - Besant Atlatl (Besant)
02 - Samantha (Besant)
03 - Timber Ridge (Avonlea)
04 - Head-Smashed-In (Avonlea)
10 - Undifferentiated Plains Side Notched (Old Women's)
11 - Washita (Old Women's)
12 - Billings (Old Women's)
13 - Cut Bank (Old Women's)
14 - Emigrant (Old Women's)
15 - Buffalo Gap (Old Women's)
16 - Paskapoo (Old Women's)
17 - Pekisko (Old Women's)
18 - (not used)
19 - (not used)
20 - Undifferentiated Prairie Side Notched (Old Women's)
21 - Nanton (Old Women's)
22 - Tompkins (Old Women's)
23 - Lewis (Old Women's)
24 - High River (Old Women's)
25 - Shaunavon (Old Women's)
26 - Irvine (Old Women's)
27 - Swift Current (Old Women's)

12 to 15 WEIGHT

16 to 19	MAXIMUM LENGTH	The distance between two imaginary parallel lines which intersect the longitudinal axis (axis of symmetry) at right angles and intersect either the tip or base at one point (Figure 87,a). The "axis of symmetry" above refers to a line which passes through the point ip about which the blade and stem edges are symmetrical.
20 to 22	MAXIMUM WIDTH	The distance between two imaginary parallel lines oriented parallel to the axis of symmetry which intersect the lateral edges at one point (Figure 87,b).
23 to 25	POSITION MAXIMUM WIDTH	The position relative to the proximal extreme of the base of the longest measurement obtained at right angles to the longitudinal axis (Figure 87,c). The "proximal extreme" above is defined as the intersection of the longitudinal axis with a perpendicular that touches the base at one point (or two if it has a perfectly symmetrical concave base).
26 to 28	MAXIMUM THICKNESS	The maximum measurement obtained between two points measured at right angles to the plane defined by the length and width measurement above (Figure 87,d).
29 to 32	POSITION MAXIMUM THICKNESS	The position of the maximum thickness as measured above relative to the proximal extreme of the base (Figure 87,e).
33 to 36	BLADE LENGTH	The length of a line drawn between the tip and the intersection of the longitudinal axis with a line drawn between the shoulders (Figure 87,f).
37 to 39	STEM LENGTH	The length of a line drawn between the intersection of the longitudinal axis with a line drawn between either the shoulders



a. maximum length
b. maximum width
c. position maximum width
d. maximum thickness
e. position maximum thickness
f. blade length
g. stem length
h. blade width
i. shoulder width
j. position shoulder width
k. neck width
L. position neck
m. stem width
n. base width
o. basal notch depth
p. notch breadth
q. notch depth
r. proximal-lateral edge height

Figure 87: Method of determining projectile point dimensions.

		or the distal extremes of the notches (whichever is more distal and the proximal extreme of the base (Figure 87,g).
40 to 42	BLADE WIDTH	The distance between two parallel lines oriented parallel to the longitudinal axis each touching the blade edge at one point (Figure 87,h).
43 to 45	SHOULDER WIDTH	The distance between two parallel lines oriented parallel to the longitudinal axis each intersecting either shoulder juncture (Figure 87,i).
46 to 48	POSITION SHOULDER WIDTH	The position of the intersection of the longitudinal axis with a line defining the shoulder width above relative to the proximal extreme of the base (Figure 87,j).
49 to 51	NECK WIDTH	The minimum distance measured between the notches (Figure 87,k).
52 to 54	POSITION NECK	The distance between the intersections of the longitudinal axis with the line defining neck width above and the proximal extreme of the base (Figure 87,l).
55 to 57	STEM WIDTH	The distance between the intersections of the longitudinal axis with the line defining neck width above and the proximal extreme of the base (Figure 87,m).
58 to 60	BASE WIDTH	The lineal distance measured between the two proximal and lateral edge junctures (Figure 87,n).
61 to 63	BASAL NOTCH DEPTH	The distance between the distal extreme of the basal concavity and the proximal extreme of the base (Figure 87,o).
64 to 66	NOTCH 1 DEPTH	The distance measured between a point halfway between the proximal lateral and distal lateral notch junctures with the furthest point away on the inner edge of the notch (Figure 87,q).

67 to 69	NOTCH 1 BREADTH	The distance measured between the proximal lateral and distal lateral notch junctures (Figure 87,p).
70 to 72	NOTCH 2 DEPTH	Same method as notch 1 depth above.
73 to 75	NOTCH 2 BREADTH	Same method as notch 1 breadth above.
76 to 78	PROXIMAL-LATERAL EDGE 1 HEIGHT	The distance between the proximal lateral notch juncture and the proximal lateral base juncture where applicable (Figure 87,r).
79 to 81	PROXIMAL-LATERAL EDGE 2 HEIGHT	Same method as proximal-lateral edge 1 height above.
82 to 84	TIP ANGLE	Where the blade edges converge uniformly to an angle at the distal end this angle is measured for the distal five millimeters of the tip.
85 to 87	BLADE ANGLE	Where the lateral blade edges are straight and uniformly converge to the distal tip the angle formed between these edges is measured with the apex occurring distally.
88 to 90	STEM ANGLE	Where the lateral stem edges converge uniformly to the proximal end from the shoulders this angle is measured with the apex occurring proximally.
91 to 93	EDGE 1 ANGLE	This is the mean angle of the juncture of the obverse and reverse faces, viewed in transverse section within 5 mm of the blade edge.
94 to 96	EDGE 2 ANGLE	Same method as edge 1 angle above.
97	INTEGRITY	0 - indeterminate fragment 1 - complete 2 - complete except distal tip 3 - distal tip and part of blade missing 4 - base or base fragment

		5 - blade intact, part of base missing 6 - midsection only 7 - tip only 8 - lateral segment 9 - tip and part of base missing
98	LONGITUDINAL CROSS SECTION	0 - indeterminate incomplete 1 - biconvex/lenticular 2 - biplano 3 - plano-convex 4 - concavo-convex/concavo triangular 5 - convexo-triangular 6 - plano-triangular 7 - diamond 8 - wedge 9 - other
99	TRANSVERSE CROSS SECTION	same codes as above
100	BLANK TYPE	0 - indeterminate/obscured 1 - flake: ventral face present 2 - flake: ventral and dorsal faces present 3 - flake: ventral/dorsal faces indistinguishable 4 - cortical flake: less than half of one face is cortex 5 - spall: most of one face is cortex 6 - pebble: both faces have cortex 7 - bipolar pebble fragment: two opposing platforms 8 - tabular slab: dorsal and/or ventral surface is a bedding or jointing plane 9 - other
101	BLANK ORIENTATION	0 - indeterminate/obscured 1 - longitudinal: platforfm proximal 2 - longitudinal: platform distal 3 - longitudinal: platform missing/bipolar 4 - transverse: platform at lateral 5 - transverse: bipolar 6 - oblique: platform at proximal lateral 7 - oblique: platform at distal lateral

8 - oblique: platform missing/bipolar
9 - other

102 FLAKING TYPE OBVERSE
0 - indeterminate, blade absent
1 - parallel
2 - expanding
3 - contracting
4 - oval-pvate
5 - irregular or multiple
6 - marginal
7 - bimodal
8 - indistinct
9 - no retouch/not applicable

103 FLAKING PATTERN OBVERSE
0 - indeterminate - blade absent
1 - non patterned
2 - transverse bilateral
3 - bidirectional: oblique
4 - bidirectional: oblique and transverse
5 -
6 -
7 -
8 - indistinct
0 - no retouch/not applicable

104 FLAKING TYPE REVERSE
See Flaking Type Obverse for codes

105 FLAKING PATTERN REVERSE
See Flaking Type Obverse for codes

106 BLADE EDGE 1 SHAPE
0 - indeterminate absent
1 - straight
2 - convex
3 - concave
4 - recurved
5 - proximally skewed convex
6 - distally skewed convex
7 - angular
8 -
9 - irregular other

107	BLADE EDGE 1 MORPHOLOGY	0 - absent/indeterminate 1 - straight even, double bevel 2 - sinuous 3 - serrated (straight) 4 - straight single bevel 5 - curved double bevel 6 - curved single bevel 7 - other 8 - broken 9 - irregular
108	BLADE EDGE 2 SHAPE	See Blade Edge 1 Shape
109	BLADE EDGE 2 MORPHOLOGY	See Blade Edge 1 Morphology for codes
110	SHOULDER SHAPE 1	0 - indeterminate/absent 1 - square angular 2 - square rounded 3 - obtuse angular 4 - obtuse rounded 5 - acute angular (barbed) 6 - acute rounded 7 - 8 - irregular 9 - not applicable
111	SHOULDER SHAPE 2	Same codes as above
112	EDGE GRINDING	0 - indeteminate 1 - base edge only 2 - base and stem 3 - base, stem, shoulder 4 - stem, shoulders 5 - stem only 6 - notches only 7 - notches and base 8 - other 9 - no grinding apparent
113	BASE SHAPE	0 - indeterminate/missing 1 - straight 2 - convex 3 - concave 4 - notched 5 - V-shaped 6 - gull wing

		7 - trivectoral 8 - irregular 9 - other
114	BASAL THINNING	0 - indeterminate 1 - none present 2 - marginal unifacial 3 - marginal bifacial 4 - extensive unifacial, multiple scars 5 - extensive bifacial, multiple scars 6 - extensive/marginal, multiple scars 7 - single extensive marginal 8 - single extensive/extensive multiple 9 - other
115	NOTCH 1 SHAPE	0 - indeterminate absent 1 - square, rectangular 2 - U-shape 3 - semicircular 4 - parabolic 5 - angular 6 - crescentic 7 - rounded V 8 - irregular/other 9 - not applicable
116	NOTCH 1 ORIENTATION	0 - indeterminate/absent 1 - transverse 2 - oblique proximally trending 3 - oblique distally trending 8 - irregular 9 - not applicable
117	NOTCH 2 SHAPE	See Notch 1 Shape for codes
118	NOTCH 2 ORIENTATION	See Notch 1 Orientation for codes
119	NOTCHING TECHNIQUE	0 - indeterminate/absent 1 - bifacial/bilateral 2 - bifacial/unifacial 3 - unifacial bilateral 4 - alternate unifacial right 5 - alternate unifacial left 6 - bifacial unilateral 7 - unifacial unilateral 8 - irregular 9 - not applicable

120	PROXIMAL-LATERAL EDGE JUNCTURE 1	
		0 - indeterminate/absent 1 - parallel 2 - expanding 3 - contracting 4 - angular 5 - sharp 6 - blunt 7 - eared 8 - tabular 9 - other irregular
121	PROXIMAL-LATERAL EDGE JUNCTURE 2	
		See Proximal Lateral Edge Juncture 1 for codes
122	TIP MORPHOLOGY	0 - indetemrinate/absent 1 - sharp 2 - blunt 3 - rounded/worn 4 - snapped excurvate 5 - snapped incurvate 6 - impact fractured 7 - truncated 8 - other 9 - irregular
123	WEAR TYPE	0 - indeterminate/absent 1 - rounding 2 - nibbling/microflaking 3 - longitudinal striations & rounding 4 - transverse striations & rounding 5 - 6 - 7 - 8 - complex wear: wear is suggestive of multiple uses 9 - other
124	WEAR LOCATION	0 - indeterminate/absent 1 - unilateral 2 - bilateral 3 - distal 4 - proximal 5 - unilateral and distal 6 - bilateral and distal 7 - medial: wear occurs on an edge formed by a fracture surface 8 - medial-lateral: wear occurs on the juncture between a lateral edge and a fracture surface 9 - other

125	HEAT TREATMENT	0 - absent 1 - discoloration attributed to heat 2 - lustre attributed to heat 3 - colour and lustre attributed to heat 4 - potlidded 5 - firebroken 6 - crazed 7 - multiple heat damage: any combination of 1 to 6 above 8 - only one fragment affected: in some instances refitting an artifact reveals a portion has been altered 9 - indeterminate

APPENDIX 3

PROJECTILE POINT DATA

PLAINS SIDE NOTCHED

CATALOGUE NUMBER:	77	2122	5200	7824	7859	7933	8520	10862	16072	2110
AREA:	1	2	11	12	2	2	2	2	2	2
UNIT:	3	999	6	501	501	502	1	4	4	999
QUADRANT; SUBQUAD.:	3.3		3.2				1,4	1,3	3,1	
LEVEL:	2		1		1	1	1	1		
DEPTH:				20					5	
CLASS:	5	5	5	5	5	5	5	5	5	5
RAW MATERIAL:	1	2	1	6	1	1	1	2	5	1
WEIGHT:	0.8*	0.4*	1.1	1.6*	0.4*	0.5*	0.9	1.2*	1.5*	0.6*
MAXIMUM LENGTH:	19.9*	13.8*	27.3*	26.3*	12.7*	16.9	18.1	19.1*	28.7	14.8*
MAXIMUM WIDTH:	13.5	10.9*	14.8	15.9	9.7	11.4*	13.9	15.3	14.6	14.8
POS. MAX. WIDTH:	7.3		2.8	2.4	8.1		4.5			3.0
MAXIMUM THICKNESS:	3.1	3.4	3.3	3.4	2.7	3.0*	3.2	3.9	3.5	3.0
POS. MAX. THICKNESS:	7.5		11.6	10.0			7.4	6.9		5.5
BLADE LENGTH:			17.7			8.7	10.6		18.9	
STEM LENGTH:	5.8	8.3	8.2	6.9	6.3	7.6	6.9	8.5	9.0	7.8
BLADE WIDTH:	13.5		14.2	14.4			12.7			13.1
SHOULDER WIDTH:	13.2		14.0	14.0	9.7		12.7			13.1
POS. SHOULDER WIDTH:	5.7		9.5	7.4	6.9	7.9	7.3	9.0	9.5	7.8
NECK WIDTH:	8.8		10.2	9.0	6.2	7.6	11.4	10.3		10.0
POS. NECK:	4.6	7.6	6.5	6.0	5.0	5.9	6.1	6.6	7.7	5.8
STEM WIDTH:			14.7	15.9	9.5		13.7	15.3		14.8
BASE WIDTH:			12.8	14.3	9.2		12.3	13.3		11.4
BASE NOTCH DEPTH:			0.3		0.2		0.5	0.3		0.2
NOTCH 1 DEPTH:	2.6	2.6	1.8	1.9	1.8		1.2			1.8
NOTCH 1 BREADTH:	2.2	2.8	3.5	2.9	3.1		1.9			4.1
NOTCH 2 DEPTH:	2.0		2.3	3.4	1.9	1.7	1.4	2.6	2.3	2.0
NOTCH 2 BREADTH:	3.2		3.9	2.8	2.9	3.8	2.0	4.2	3.3	3.5
PROX.-LAT. EDGE 1 HT.	3.6	6.5	4.2		2.9		5.4			3.3
PROX.-LAT. EDGE 2 HT.			4.2	3.5	2.8	4.2	3.7	4.5	5.2	3.4
TIP ANGLE:			75			80	70		90	
BLADE ANGLE:	40		35	15			55			
EDGE 1 ANGLE:	50		50	55			75		55	
EDGE 2 ANGLE:	55		50	50			75		55	
INTEGRITY:	5	9	1	2	2	8	1	3	5	2
LONG. X SEC.:	1		4	2	2		2	9	1	2
TRANS. X SEC.:	1		1	1	1	1	2	3	1	1
BLANK TYPE:						4	1	3		
BLANK ORIENTATION:										
FLA KING TYPE OBVERSE:	5		5	5	5		5	6	5	5
FLA KING PATTERN OBVERSE:	1		1	1	1		1	1	1	3
FLA KING TYPE REVERSE:	5		5	5	5	5	5	5	5	5
FLAKING PATTERN REVERSE:	1		1	1	1	1	1	1	1	3
BLADE EDGE 1 SHAPE:	2		2	1			1		2	1
BLADE EDGE 1 MORPHOLOGY:	2		1	3			1		2	2
BLADE EDGE 2 SHAPE:	2		2	1		1	1	1	2	9
BLADE EDGE 2 MORPHOLOGY:	2		1	2		3	1	1	2	5
SHOULDER 1 SHAPE:	8	2	3	1	1		4			1
SHOULDER 2 SHAPE:	1		3		1	1	1	2	3	1
EDGE GRINDING:	9	9	9	5	9	9	9	2	9	9
BASE SHAPE:	1	3	3	1	1		1	3	3	3
BASAL THINNING:	6		3	3	6	6	3	3	5	6
NOTCH 1 SHAPE:	2	2	5	5	1		5			4
NOTCH 1 ORIENTATION:	1	1	1	3	3		1			1
NOTCH 2 SHAPE:	4		5	2	1	2	3	5	7	7
NOTCH 2 ORIENTATION:	1		1	3	3	1	1	1	1	1
NOTCHING TECHNIQUE:	5		4	1	1		1			1
PROX.-LAT EDGE 1:	1	1	3		1		3	1		1
PROX.-LAT EDGE 2:			1	1	3	1	3	3	1	9
TIP MORPHOLOGY:	6		1	5	7	1	1		1	9
WEAR TYPE:									1	
WEAR LOCATION:									1	
HEAT TREATMENT:						7				
FIGURE REFERENCE	37.h	46.ee	38.o	37.n	38.q	37.j	38.t	37.1	37.k	37.c

(* = Incomplete)

PLAINS SIDE NOTCHED

			MEAN	MIN	MAX
CATALOGUE NUMBER:	3533				
AREA:	11				
UNIT:	519				
QUADRANT; SUBQUAD.:					
LEVEL:					
DEPTH:					
CLASS:	5				
RAW MATERIAL:	5				
WEIGHT:	0.8*		1.0	0.9	1.6*
MAXIMUM LENGTH:	20.6*		22.75	16.9	28.7
MAXIMUM WIDTH:	11.4		13.8	9.7	15.9
POS. MAX. WIDTH:	7.5		5.1	2.4	8.1
MAXIMUM THICKNESS:	3.2		3.3	2.7	3.9
POS. MAX. THICKNESS:	13.6		8.9	5.5	13.6
BLADE LENGTH:	13.0*		14.0	8.7	18.9
STEM LENGTH:	6.5		7.4	5.8	9.0
BLADE WIDTH:	11.3		13.2	11.3	14.4
SHOULDER WIDTH:	11.3		12.6	9.7	14.0
POS. SHOULDER WIDTH:	7.6		7.9	5.7	9.5
NECK WIDTH:	6.1		8.8	6.1	11.4
POS. NECK:	5.2		6.1	4.6	7.7
STEM WIDTH:	9.6		13.4	9.5	15.9
BASE WIDTH:	6.9		11.5	6.9	14.3
BASAL NOTCH DEPTH:			0.3	0.2	0.5
NOTCH 1 DEPTH:	2.4				
NOTCH 1 BREADTH:	3.4				
NOTCH 2 DEPTH:	1.9	(1+2)	2.1	1.2	3.4
NOTCH 2 BREADTH:	3.6	(1+2)	3.2	1.9	4.2
PROX.-LAT. EDGE 1 HT.	3.3				
PROX.-LAT. EDGE 2 HT.	2.4	(1+2)	39	2.9	6.5
TIP ANGLE:			78.7	70	90
BLADE ANGLE:	30		35	15	55
EDGE 1 ANGLE:	45				
EDGE 2 ANGLE:	45	(1+2)	55	45	75
INTEGRITY:	2				
LONG. X SEC.:	2				
TRANS. X SEC.:	1				
BLANK TYPE:					
BLANK ORIENTATION:					
FLA KING TYPE OBVERSE:	6				
FLA KING PATTERN OBVERSE:	1				
FLA KING TYPE REVERSE:	6				
FLAKING PATTERN REVERSE:	1				
BLADE EDGE 1 SHAPE:	6				
BLADE EDGE 1 MORPHOLOGY:	4				
BLADE EDGE 2 SHAPE:	1				
BLADE EDGE 2 MORPHOLOGY:	1				
SHOULDER 1 SHAPE:	1				
SHOULDER 2 SHAPE:	3				
EDGE GRINDING:	2				
BASE SHAPE:	1				
BASAL THINNING:	3				
NOTCH 1 SHAPE:	8				
NOTCH 1 ORIENTATION:	3				
NOTCH 2 SHAPE:	2				
NOTCH 2 ORIENTATION:	1				
NOTCHING TECHNIQUE:	5				
PROX.-LAT EDGE 1:	8				
PROX.-LAT EDGE 2:	1				
TIP MORPHOLOGY:	7				
WEAR TYPE:	2				
WEAR LOCATION:	3				
HEAT TREATMENT:					
FIGURE REFERENCE	37.g				

(* = Incomplete)

SMALL NOTCHED

CATALOGUE NUMBER:	62	100	992	2060	2061	2120	2112	2123	3458	5012
AREA:	1	1	1	1	1	2	2	2	2	11
UNIT:	3	4	8	740	740	999	999	999	999	542
QUADRANT; SUBQUAD.:	4,4	4,4								
LEVEL:	1	1	1							
DEPTH:			9							
CLASS:	5	5	5	5	5	3	5	5	5	5
RAW MATERIAL:	1	1	1	1	1	1	1	1	1	1
WEIGHT:	0.4*	0.2*	0.5	0.3	0.4*	0.4*	0.6*	0.5	1.2*	0.4*
MAXIMUM LENGTH:	13.7*	9.3	16.8	13.2	13.3*	11.3*	16.1*	14.6	23.8	12.7*
MAXIMUM WIDTH:	11.4	9.7	13.3	9.8	12.0*	10.4	10.8	9.4	15.2	11.6.
POS. MAX. WIDTH:	6.7	1.3	6.6						5.8	1.0
MAXIMUM THICKNESS:	2.6	2.3	2.4	2.5	3.1	2.6	3.6	3.5	3.9	2.8
POS. MAX. THICKNESS:	4.4	4.6	6.8	5.1				5.2	12.5	6.7
BLADE LENGTH:		4.3*	10.9	9.2				8.0	18.6	
STEM LENGTH:	5.1	5.0	5.1	4.0	5.1	5.4	6.8	6.6	5.9	6.9
BLADE WIDTH:	11.4	7.8	13.2	9.7			10.3	8.9	15.2	
SHOULDER WIDTH:	11.0	7.8	12.9	9.7		9.8	10.1		14.9	
POS. SHOULDER WIDTH:	5.1	5.0	5.4	4.0		5.6	7.5	6.6	4.8	
NECK WIDTH:	8.7	7.0	7.3	8.5	9.0	7.8	7.7	8.0	8.5	8.1
POS. NECK:	4.3	3.6	4.2	3.0	3.8	4.3	5.2	4.6	5.2	5.5
STEM WIDTH:	10.2	9.7	11.2			9.7				11.5
BASE WIDTH:	8.3	6.4	9.3			6.7				10.0
BASAL NOTCH DEPTH:	0.9	0.1		0.6					2.5	0.5
NOTCH 1 DEPTH:	1.0	0.4	2.7	1.4		1.3		1.4		
NOTCH 1 BREADTH:	2.8	2.8	2.7	2.5		2.2	5.1			
NOTCH 2 DEPTH:	0.6	0.9	2.9		0.8	1.3	1.4		2.4	1.6
NOTCH 2 BREADTH:	2.0	1.8	3.1		2.7	2.8	3.8		2.8	2.8
PROX.-LAT. EDGE 1 HT.	3.0									3.4
PROX.-LAT. EDGE 2 HT.										
TIP ANGLE:			80	60				80		
BLADE ANGLE:			55	55				65		
EDGE 1 ANGLE:	55	60	45	35				60	40	
EDGE 2 ANGLE:	55	60	45	40				50	45	
INTEGRITY:	2	2	1	5	9	2	9	5	5	3
LONG. X SEC.:	2	1	2	6		2	3	3	9	2
TRANS. X SEC.:	2	1	1	1	1	8	3	3	1	
BLANK TYPE:	3	3	2			2				
BLANK ORIENTATION:						1				
FLA KING TYPE OBVERSE:	5	6	6	5		6	5	5	5	
FLA KING PATTERN OBVERSE:	4	1	1	1		1	2	1	1	
FLA KING TYPE REVERSE:	5	5	6	5		6	5	5	5	5
FLAKING PATTERN REVERSE:	4	1	1	1		1	2	1	1	1
BLADE EDGE 1 SHAPE:	1	2	2	2		1	1	2	2	
BLADE EDGE 1 MORPHOLOGY:	2	8	2	2		9	2	4	1	
BLADE EDGE 2 SHAPE:	5	2	2	1		9	1	2	2	
BLADE EDGE 2 MORPHOLOGY:	2	8	1	2		8	2	6	1	
SHOULDER 1 SHAPE:	4	3	6	3	1	3	3	1	1	
SHOULDER 2 SHAPE:	2	3	6	3			8		5	1
EDGE GRINDING:	7	1	9	5		9	6	9	9	2
BASE SHAPE:	3	3	2	3		1		1	3	1
BASAL THINNING:	3	8	2	6	1	7			8	3
NOTCH 1 SHAPE:	5	6	7	2		2	7	4		
NOTCH 1 ORIENTATION:	1	1	3	1		1	1	3		
NOTCH 2 SHAPE:	4	4	7		2	4	4		2	4
NOTCH 2 ORIENTATION:	1	1	3		1	3	1		3	1
NOTCHING TECHNIQUE:	2	2	1	5		1	1		1	1
PROX.-LAT EDGE 1:	3	5	7	7		9	9	7		1
PROX.-LAT EDGE 2:	7	8	7		8	9			7	7
TIP MORPHOLOGY:	4	6	4	4			7	1	5	9
WEAR TYPE:										
WEAR LOCATION:										
HEAT TREATMENT:										
FIGURE REFERENCE	39.n	39.d	39.a	38.f	45.u	39.m	45.y	38.e	37.i	38.r

(* = Incomplete)

SMALL NOTCHED

CATALOGUE NUMBER:	7767	7812	9026	10384	10385	10509	10802	11081	11433	11434
AREA:	11	2	2	2	2	2	2	2	2	2
UNIT:	11	11	1	999	999	4	4	4	4	4
QUADRANT; SUBQUAD.:	2,1	3,4	2,3			1,1	1,2	1,4	2,2	2,2
LEVEL:	1	1	1			1	1	1	1	1
DEPTH:								6		
CLASS:	5	5	5	5	5	3	5	5	5	5
RAW MATERIAL:	1	7	7	7	2	1	1	5	1	2
WEIGHT:	1.1*	0.4	0.5	0.8*	0.4*	0.2	0.8*	0.6	0.3	0.4*
MAXIMUM LENGTH:	19.6*	16.2	17.9	16.5*	15.2*	11.1	14.0*	14.9	13.2	12.5*
MAXIMUM WIDTH:	15.9*	8.9	11.4	12.1	9.9	10.1	14.6	10.8	9.4	12.2
POS. MAX WIDTH:		1.9	7.6	7.0		3.6	7.0	2.2	6.2	6.1
MAXIMUM THICKNESS:	3.5	2.2	2.8	3.6	2.7	2.0	3.2	3.2	3.3	2.4
POS. MAX. THICKNESS:		6.0	8.7	5.8		2.8	4.1	5.2		
BLADE LENGTH:		11.2	10.5			7.6		8.5	6.8	
STEM LENGTH:		4.7	6.7	5.5		3.0	6.6	6.2	6.0	5.8
BLADE WIDTH:	13.5	8.4	11.2	12.0		9.9	14.6	10.0	9.2	12.1
SHOULDER WIDTH:	13.1	8.3	11.0	11.9		9.9	14.6	9.9	9.4	12.3
POS. SHOULDER WIDTH:	6.6	4.8	6.8	6.2	5.9	3.7	6.9	6.6	6.2	
NECK WIDTH:	9.7	6.6	7.2	8.5		8.3	8.5	9.2	6.1	9.1
POS. NECK:	5.8	3.8	4.8	4.2		2.2	4.7	4.9	3.8	4.1
STEM WIDTH:		8.9	10.0	10.9		9.3	12.9	10.8		
BASE WIDTH:		8.5	10.00	9.7		8.8	12.7	9.6		
BASAL NOTCH DEPTH:					1.7					
NOTCH 1 DEPTH:		1.5	1.7		3.7	1.1	2.5	0.7		1.7
NOTCH 1 BREADTH:		2.2	4.5			2.6	3.4	2.9		4.1
NOTCH 2 DEPTH:	2.1	1.1	1.7	1.5		0.9	2.9	0.8		
NOTCH 2 BREADTH:	3.6	2.3	4.0	3.0		1.9	4.4	3.2		
PROX.-LAT. EDGE 1 HT.							1.6			2.2
PROX.-LAT. EDGE 2 HT.							1.0			
TIP ANGLE:			80					80	90	
BLADE ANGLE:				20				45	60	
EDGE 1 ANGLE:		65	70			50	70	65		
EDGE 2 ANGLE:	40	65	50			65		70	70	
INTEGRITY:	9	1	1	2	2	1	2	1	1	2
LONG. X SEC.:	1	2	8	2	2	2	2	3	9	2
TRANS. X SEC.:	1	2	1	1	6	3	1	3	3	3
BLANK TYPE:		3	2		3	2				4
BLANK ORIENTATION:						1				
FLA KING TYPE OBVERSE:	7	6	6	5	6	6	5	5	5	6
FLA KING PATTERN OBVERSE:	4	1	1	1	1	1	1	1	1	1
FLA KING TYPE REVERSE:	7	6	6	5		6	5	5	5	5
FLAKING PATTERN REVERSE:	4	1	1	1		1	1	1	1	1
BLADE EDGE 1 SHAPE:		9	5	1		5		2	1	
BLADE EDGE 1 MORPHOLOGY:		9	3	1	2	1		2	2	
BLADE EDGE 2 SHAPE:	1	9	2	1		2		1	1	
BLADE EDGE 2 MORPHOLOGY:	1	4	3	2		1	1	2		
SHOULDER 1 SHAPE:	1	1	4	3	1	3	2	4	3	3
SHOULDER 2 SHAPE:	3	8	2	2	1	4	3	3	1	2
EDGE GRINDING:	9	9	9	7	9	2	7	9	9	3
BASE SHAPE:	3	2	2	1	1	1	8	2	8	
BASAL THINNING:		3	3	6	3	2	6	3	3	6
NOTCH 1 SHAPE:		2	5		5	7	7	6	5	4
NOTCH 1 ORIENTATION:		3	1	1	1	3	1	1	1	1
NOTCH 2 SHAPE:	5	7	4	5	2	4	7	6	8	5
NOTCH 2 ORIENTATION:	1	1	3	3	1	1	1	1	1	1
NOTCHING TECHNIQUE:		1	1		5	1	5	3	1	4
PROX.-LAT EDGE 1:		6	7		9	5	6	9	3	1
PROX.-LAT EDGE 2:	1	5	7	7		3	6	6	5	
TIP MORPHOLOGY:		3	1	4	6	2	6	1	1	6
WEAR TYPE:		4		1						1
WEAR LOCATION:		6		1						1
HEAT TREATMENT:					1				4	
FIGURE REFERENCE:	38.s	37.e	37.d	39.o	39.i	38.h	37.b	39.f	39.g	46.w

(* = Incomplete)

SMALL NOTCHED

CATALOGUE NUMBER:	16030	16076	16811	16910	17405	18096	19048
AREA:	2	2	2	2	2	2	2
UNIT:	4	4	4	4	4	6	21
QUADRANT; SUBQUAD.:	2,4	3,1	3,4	3,4	4,2	2,4	2
LEVEL:	2	1	1	1	1	1	2
DEPTH:							
CLASS:	5	5	5	3	5	5	5
RAW MATERIAL:	2	1	5	5	6	18	1
WEIGHT:	0.4*	0.7*	0.4	0.6*	0.6*	0.7*	0.5
MAXIMUM LENGTH:	13.3*	16.1*	13.9	20.0	15.0*	16.0*	13.9*
MAXIMUM WIDTH:	10.8	14.5	10.4	13.1	12.7	15,0*	11.6
POS. MAX WIDTH:			8.6		6.2		5.7
MAXIMUM THICKNESS:	2.6	4.2	2.8	2.1	3.1	2.4*	2.7
POS. MAX. THICKNESS:	7.4	7.9	6.1				5.1
BLADE LENGTH:		7.3	7.1	15.6			9.4
STEM LENGTH:	5.7	7.8	5.5	4.5	4.7	7.3	4.4
BLADE WIDTH:	10.3		9.4		12.4		11.5
SHOULDER WIDTH:	10.7*		8.7	12.9	12.7		11.2
POS. SHOULDER WIDTH:	6.0		7.2	4.4	5.7	7.3	4.8
NECK WIDTH:	7.6	10.4	6.8	9.9	9.0		8.9
POS. NECK:	3.8	7.2	4.6	3.7	3.5	5.1	3.3
STEM WIDTH:	10.8		9.1		11.5		11.0
BASE WIDTH:	10.8		9.1		10.8		10.1
BASAL NOTCH DEPTH:					0.5		0.2
NOTCH 1 DEPTH:	1.9	2.8	1.4	1.5	1.8	1.4	1.0
NOTCH 1 BREADTH:	4.0	8.7	3.0	2.5	3.0	4.5	2.8
NOTCH 2 DEPTH:			1.6		1.6		1.4
NOTCH 2 BREADTH:			4.6		2.8		3.9
PROX.-LAT. EDGE 1 HT.					1.7	2.1	1.0
PROX.-LAT. EDGE 2 HT.							
TIP ANGLE:			80	85			
BLADE ANGLE:	45				40		
EDGE 1 ANGLE:		60	55				45
EDGE 2 ANGLE:			45	60			45
INTEGRITY:	2	3	1	5	2	8	2
LONG. X SEC.:	1		1	1	1		3
TRANS. X SEC.:	1		1	2	1		3
BLANK TYPE:							2
BLANK ORIENTATION:							
FLA KING TYPE OBVERSE:	5		5	6	5		6
FLA KING PATTERN OBVERSE:	1		1	1	1		1
FLA KING TYPE REVERSE:	5		5	6	5		6
FLAKING PATTERN REVERSE:	1		1	1	1		1
BLADE EDGE 1 SHAPE:	1		1	1	2		2
BLADE EDGE 1 MORPHOLOGY:	1		1	8	1		1
BLADE EDGE 2 SHAPE:	1		1	2			2
BLADE EDGE 2 MORPHOLOGY:	1		1	2			1
SHOULDER 1 SHAPE:	2	4	6	1	1	1	3
SHOULDER 2 SHAPE:			8	3	4		3
EDGE GRINDING:	9	6	9	1	9	2	2
BASE SHAPE:	1	1	1	1	1	1	1
BASAL THINNING:	6	6	3	3	5		6
NOTCH 1 SHAPE:	8	7	4	4	5	2	4
NOTCH 1 ORIENTATION:	3	1	3	3	3	1	3
NOTCH 2 SHAPE:			8		4		7
NOTCH 2 ORIENTATION:			3		2		1
NOTCHING TECHNIQUE:	4	1	2	1	1		3
PROX.-LAT EDGE 1:	5	9	6	7	7	2	1
PROX.-LAT EDGE 2:	5		5		7		7
TIP MORPHOLOGY:	7		1	1	9		6
WEAR TYPE:							
WEAR LOCATION:							
HEAT TREATMENT:				4		5	
FIGURE REFERENCE:	39.j	38.a	39.h	37.f	37.a	38.b	39.b

(* = Incomplete)

SMALL NOTCHED

	MEAN	MIN	MAX
CATALOGUE NUMBER:			
AREA:			
UNIT:			
QUADRANT; SUBQUAD.:			
LEVEL:			
DEPTH:			
CLASS:			
RAW MATERIAL:			
WEIGHT:	0.4	0.2	1.2*
MAXIMUM LENGTH:	15.4	9.2	23.8
MAXIMUM WIDTH:	11.4	8.9	15.9*
POS. MAX WIDTH:	5.2	1.0	8.6
MAXIMUM THICKNESS:	2.9	2.0	4.2
POS. MAX. THICKNESS:	6.1	2.8	12.5
BLADE LENGTH:	10.0	6.8	18.6
STEM LENGTH:	5.6	3.0	7.8
BLADE WIDTH:	11.0	7.8	15.2
SHOULDER WIDTH:	11.1	7.8	14.9
POS. SHOULDER WIDTH:	5.8	3.7	7.5
NECK WIDTH:	8.3	6.1	10.4
POS. NECK:	4.3	2.2	7.2
STEM WIDTH:	10.5	8.9	12.9
BASE WIDTH:	9.4	6.4	12.7
BASAL NOTCH DEPTH:	0.9	0.1	2.5
NOTCH 1 DEPTH:	2.5	0.4	3.7
NOTCH 1 BREADTH:	3.3	1.8	8.7
NOTCH 2 DEPTH:			
NOTCH 2 BREADTH:			
PROX.-LAT. EDGE 1 HT.	2.0	1.0	3.4
PROX.-LAT. EDGE 2 HT.			
TIP ANGLE:	79.4	60	90
BLADE ANGLE:	48	20	65
EDGE 1 ANGLE:	54.8	35	70
EDGE 2 ANGLE:			
INTEGRITY:			
LONG. X SEC.:			
TRANS. X SEC.:			
BLANK TYPE:			
BLANK ORIENTATION:			
FLA KING TYPE OBVERSE:			
FLA KING PATTERN OBVERSE:			
FLA KING TYPE REVERSE:			
FLAKING PATTERN REVERSE:			
BLADE EDGE 1 SHAPE:			
BLADE EDGE 1 MORPHOLOGY:			
BLADE EDGE 2 SHAPE:			
BLADE EDGE 2 MORPHOLOGY:			
SHOULDER 1 SHAPE:			
SHOULDER 2 SHAPE:			
EDGE GRINDING:			
BASE SHAPE:			
BASAL THINNING:			
NOTCH 1 SHAPE:			
NOTCH 1 ORIENTATION:			
NOTCH 2 SHAPE:			
NOTCH 2 ORIENTATION:			
NOTCHING TECHNIQUE:			
PROX.-LAT EDGE 1:			
PROX.-LAT EDGE 2:			
TIP MORPHOLOGY:			
WEAR TYPE:			
WEAR LOCATION:			
HEAT TREATMENT:			
FIGURE REFERENCE:			

(* = Incomplete)

AVONLEA

CATALOGUE NUMBER:	3580	7958	7857	7764	13927	14077	16310	16328	16550	17291
AREA:	11	2	12	11	2	2	2	2	2	2
UNIT:	527	502	4	11	3	3	4	4	4	4
QUADRANT; SUBQUAD.:			4	1,4	1,2	2,3	3,1	3,2	3,2	4,1
LEVEL:		2	2	2	1	1	2	1	1	2
DEPTH:						5				
CLASS:	5	5	5	5	5	5	5	3	5	5
RAW MATERIAL:	1	2	2	1	2	1	16	2	2	1
WEIGHT:	0.3*	0.2	0.4*	0.3*	0.1*	0.4	0.3	0.2*	0.4*	0.2*
MAXIMUM LENGTH:	6.5*	13.8	13.2*	11.4*	4.5*	16.6	12.0	9.7*	15.9	8.5*
MAXIMUM WIDTH:	12.2*	10.6	10.9	10.3*	4.6*	12.0	12.0	12.2*	11.4	10.3*
POS. MAX WIDTH:		0.2	4.4			1.5	5.7		0.8	
MAXIMUM THICKNESS:	2.9	2.1	2.4	2.2	1.9*	2.7	2.5	1.9	2.4	2.9
POS. MAX. THICKNESS:		3.0	6.4			5.4	10.0		7.5	
BLADE LENGTH:		10.2				11.9	6.1			
STEM LENGTH:	5.1	3.4	4.1			3.8	4.4		4.3	
BLADE WIDTH:		8.8	10.8			10.4	9.9		10.3	
SHOULDER WIDTH:		8.8	10.8			10.4	10.5		10.3	
POS. SHOULDER WIDTH:		3.6	4.3	3.2		4.4	5.0		4.6	
NECK WIDTH:	9.9	8.1	9.4			10.0	9.7		8.1	
POS. NECK:		2.2	3.1	1.5		2.8	3.5		3.4	
STEM WIDTH:		10.6	10.3			12.0	12.0		11.4	
BASE WIDTH:		10.4	9.3			11.7	9.3		11.1	
BASAL NOTCH DEPTH:		0.7	0.5			0.4	0.6		0.8	
NOTCH 1 DEPTH:		1.2	0.7			0.8	1.2		1.3	
NOTCH 1 BREADTH:		1.7	2.0			2.8	3.8		2.4	
NOTCH 2 DEPTH:		1.1	0.7	1.0		0.8	1.1	1.1	1.6	
NOTCH 2 BREADTH:		2.2	2.3	2.4		2.7	2.4	2.6	2.1	
PROX.-LAT. EDGE 1 HT.	1.4		2.0		2.6	2.1			2.0	
PROX.-LAT. EDGE 2 HT.		1.2	1.8			1.1		2.7	2.0	2.9
TIP ANGLE:		60				60	75			
BLADE ANGLE:		40				45	70		35	
EDGE 1 ANGLE:		40	40			55	70		55	
EDGE 2 ANGLE:		55	40			55	70		50	
INTEGRITY:	4	1	2	9	4	1	1	8	2	8
LONG. X SEC.:		8	2	2		1	2		1	
TRANS. X SEC.:		1	1	1		1	1		1	
BLANK TYPE:		9				3		3		
BLANK ORIENTATION:										
FLA KING TYPE OBVERSE:		7	5			7	7		1	
FLA KING PATTERN OBVERSE:		4	1		1	3		4		
FLA KING TYPE REVERSE:		1	5			7	7		5	
FLAKING PATTERN REVERSE:	1	1			4	3		2		
BLADE EDGE 1 SHAPE:		1	2			2	1		1	
BLADE EDGE 1 MORPHOLOGY:		1	2			1	2		1	
BLADE EDGE 2 SHAPE:		1	2	2		1	1		1	
BLADE EDGE 2 MORPHOLOGY:		1	1	1		2	1		1	
SHOULDER 1 SHAPE:		3	3			3	3		1	
SHOULDER 2 SHAPE:	3	3	3	3		4	3	3	1	
EDGE GRINDING:	9	9	1	9	9	9	7	9	9	9
BASE SHAPE:	3	3	3			3	3	1	3	3
BASAL THINNING:	3	2	5			5	5	3	5	5
NOTCH 1 SHAPE:		7	7			7	7		5	
NOTCH 1 ORIENTATION:		1	1			2	2		1	
NOTCH 2 SHAPE:		6	6	7		7	7	4	7	5
NOTCH 2 ORIENTATION:		2	1	1		2	1	2	1	1
NOTCHING TECHNIQUE:	2	5	3			3	3	2		
PROX.-LAT EDGE 1:	2	5	3			3	9		2	
PROX.-LAT EDGE 2:		2	3			1	7	1	2	1
TIP MORPHOLOGY:		1	5			1	1		4	
WEAR TYPE:										
WEAR LOCATION:										
HEAT TREATMENT:		3								7
FIGURE REFERENCE:	41.k	41.e	41.f	41.g	41.1	41.a	41.d	41.h	41.c	41.i

(* = Incomplete)

AVONLEA

CATALOGUE NUMBER:	19047	21192			
AREA:	2	2			
UNIT:	21	6			
QUADRANT; SUBQUAD.:	2				
LEVEL:	1				
DEPTH:	5	5			
CLASS:					
RAW MATERIAL:	1	2	MEAN	MIN	MAX
WEIGHT:	0.9*	0.1*	0.3	0.2	0.9*
MAXIMUM LENGTH:	19.3*	5.2*	14.1	12.0	19.3*
MAXIMUM WIDTH:	14.2	11.0	11.7	10.6	14.2
POS. MAX WIDTH:	5.2		3.0	0.2	5.7
MAXIMUM THICKNESS:	2.9	2.2	2.5	1.9	2.9
POS. MAX. THICKNESS:	7.4		6.6	3.0	10.0
BLADE LENGTH:			9.4	6.1	11.9
STEM LENGTH:	4.9		4.3	3.4	5.1
BLADE WIDTH:	13.9		10.7	8.8	13.9
SHOULDER WIDTH:	13.9		10.8	8.8	13.9
POS. SHOULDER WIDTH:	5.2		4.3	3.3	5.2
NECK WIDTH:	11.2	9.1	9.4	8.1	11.2
POS. NECK:	3.9	2.9	2.9	1.5	3.9
STEM WIDTH:	13.7		11.7	10.3	13.7
BASE WIDTH:	12.3	10.5	10.7	9.3	11.7
BASAL NOTCH DEPTH:	0.7	0.5	0.6	0.4	0.8
NOTCH 1 DEPTH:	1.6		1.1	0.7	1.6
NOTCH 1 BREADTH:	2.8		2.5	1.7	3.8
NOTCH 2 DEPTH:	1.6				
NOTCH 2 BREADTH:	2.3				
PROX.-LAT. EDGE 1 HT.	2.3	1.9	2.1	1.1	3.1
PROX.-LAT. EDGE 2 HT.	3.1	2.1			
TIP ANGLE:			65	60	75
BLADE ANGLE:			47.5	35	70
EDGE 1 ANGLE:	40		51.2	40	70
EDGE 2 ANGLE:					
INTEGRITY:	2	4			
LONG. X SEC.:	1				
TRANS. X SEC.:	1				
BLANK TYPE:					
BLANK ORIENTATION:					
FLA KING TYPE OBVERSE:	5				
FLA KING PATTERN OBVERSE:	1				
FLA KING TYPE REVERSE:	5				
FLAKING PATTERN REVERSE:	1				
BLADE EDGE 1 SHAPE:	2				
BLADE EDGE 1 MORPHOLOGY:	2				
BLADE EDGE 2 SHAPE:	2				
BLADE EDGE 2 MORPHOLOGY:	1				
SHOULDER 1 SHAPE:	1				
SHOULDER 2 SHAPE:	1				
EDGE GRINDING:	7	2			
BASE SHAPE:	3	3			
BASAL THINNING:	5	5			
NOTCH 1 SHAPE:	6				
NOTCH 1 ORIENTATION:	1				
NOTCH 2 SHAPE:	6				
NOTCH 2 ORIENTATION:	1				
NOTCHING TECHNIQUE:	1	5			
PROX.-LAT EDGE 1:	1	1			
PROX.-LAT EDGE 2:	1	1			
TIP MORPHOLOGY:	4				
WEAR TYPE:					
WEAR LOCATION:					
HEAT TREATMENT:					
FIGURE REFERENCE:	41.b	41.j			

(* = Incomplete)

BESANT

CATALOGUE NUMBER:	2124	3587	5181	7858	14836
AREA:	2	11	11	1	2
UNIT:	999	528	6	999	6
QUADRANT; SUBQUAD.:			1,1		2,2
LEVEL:			5		1
DEPTH:					2
CLASS:	5	3	5	5	5
RAW MATERIAL:	2	1	2	1	1
WEIGHT:	1.2*	1.9	1.2*	4.0*	1.3*
MAXIMUM LENGTH:	10.5*	20.2	13.1*	25.1*	19.2*
MAXIMUM WIDTH:	19.5*	15.2	19.2*	22.4	19.7
POS. MAX WIDTH:		8.4		10.2	
MAXIMUM THICKNESS:	6.3	5.4	5.4	7.0	5.1
POS. MAX. THICKNESS:		11.4		13.7	
BLADE LENGTH:		12.0		14.7*	
STEM LENGTH:		7.0		10.2	10.5
BLADE WIDTH:		15.0		22.1	
SHOULDER WIDTH:		15.0		22.1	
POS. SHOULDER WIDTH:		8.1		11.3	
NECK WIDTH:	15.8	12.7	16.7	15.3	16.0
POS. NECK:	0.7	6.0		6.8	7.0
STEM WIDTH:	19.5	13.5		19.8	19.5
BASE WIDTH:	16.8	12.7		18.1	
BASAL NOTCH DEPTH:	1.0	0.6		1.2	0.7
NOTCH 1 DEPTH:		0.9	1.3	3.1	1.8
NOTCH 1 BREADTH:		3.7	4.7	7.6	6.0
NOTCH 2 DEPTH:		1.6		2.4	
NOTCH 2 BREADTH:		5.0		6.4	
PROX.-LAT. EDGE 1 HT.					
PROX.-LAT. EDGE 2 HT.					
TIP ANGLE:					
BLADE ANGLE:				56	
EDGE 1 ANGLE:		75		75	
EDGE 2 ANGLE:		85		75	
INTEGRITY:	4	1	3	2	3
LONG. X SEC.:		1		1	9
TRANS. X SEC.:		1		1	
BLANK TYPE:					2
BLANK ORIENTATION:					
FLA KING TYPE OBVERSE:		5		5	
FLA KING PATTERN OBVERSE:		1		1	
FLA KING TYPE REVERSE:		5		5	
FLAKING PATTERN REVERSE:		1		1	
BLADE EDGE 1 SHAPE:		2		2	
BLADE EDGE 1 MORPHOLOGY:		1		2	
BLADE EDGE 2 SHAPE:		6		2	
BLADE EDGE 2 MORPHOLOGY:		1		2	
SHOULDER 1 SHAPE:		3	3	3	4
SHOULDER 2 SHAPE:		1		8	
EDGE GRINDING:	2	9	7	5	7
BASE SHAPE:	3	6	3	3	1
BASAL THINNING:	6	2		7	3
NOTCH 1 SHAPE:		6	6	4	5
NOTCH 1 ORIENTATION:		1	1	1	1
NOTCH 2 SHAPE:		4		4	
NOTCH 2 ORIENTATION:		3		3	
NOTCHING TECHNIQUE:	1	2		1	1
PROX.-LAT EDGE 1:	7	6	9	7	7
PROX.-LAT EDGE 2:	7	6		7	
TIP MORPHOLOGY:		5	6		
WEAR TYPE:		1			
WEAR LOCATION:		2			
HEAT TREATMENT:			7		7
FIGURE REFERENCE:	42.g	38.k	42.f	42.c	42.h

(* = Incomplete)

TRIANGULAR

CATALOGUE NUMBER:	2058	6741	7956	8875	9017	9025	9086	9651	11132	11139
AREA:	1	11	2	2	2	2	2	2	2	2
UNIT:	738	9	502	1	1	1	1	2	4	4
QUADRANT; SUBQUAD.:		3,3		2,2	2,3	2,3	2,3	1,4	1,4	1,4
LEVEL:		1	2	1	1	1	1	1	2	2
DEPTH:					4	5				
CLASS:	5	5	5	5	5	5	5	3	5	5
RAW MATERIAL:	1	2	1	1	1	16	1	1	1	1
WEIGHT:	0.4*	0.5	0.2*	0.5*	1.1*	0.3	0.4*	0.3*	0.2*	0.3*
MAXIMUM LENGTH:	8.9*	14.9	9.9*	13.0*	17.2*	14.3	14.8*	14.3	10.9*	9.9*
MAXIMUM WIDTH:	12.1	10.4	8.9	11.8	15.5	12.2	9.2*	10.2*	8.8	11.4
POS. MAX WIDTH:	0	3.6	2.9	4.5	6.7	2.6	0	0	2.4	3.1
MAXIMUM THICKNESS:	3.1	3.5	2.5	2.9	4.2	2.4	3.1	2.2	2.0	2.1
POS. MAX. THICKNESS:		6.0	7.3		9.4	4.3			5.1	5.6
BLADE LENGTH:										
STEM LENGTH:										
BLADE WIDTH:										
SHOULDER WIDTH:										
POS. SHOULDER WIDTH:										
NECK WIDTH:										
POS. NECK:										
STEM WIDTH:										
BASE WIDTH:	10.0	8.4	8.8	10.1	11.8	11.5			6.8	11.3
BASAL NOTCH DEPTH:					0.3	0.5				
NOTCH 1 DEPTH:										
NOTCH 1 BREADTH:										
NOTCH 2 DEPTH:										
NOTCH 2 BREADTH:										
PROX.-LAT. EDGE 1 HT.										
PROX.-LAT. EDGE 2 HT.										
TIP ANGLE:							65			
BLADE ANGLE:								40	50	
EDGE 1 ANGLE:					45		60	35	35	
EDGE 2 ANGLE:										
INTEGRITY:	4	1	9	2	2	1	8	5	2	2
LONG. X SEC.:		3	2	2	3	1	2	2	9	3
TRANS. X SEC.:		3	1	1	1	1		2	9	6
BLANK TYPE:	3				1			2		3
BLANK ORIENTATION:										
FLA KING TYPE OBVERSE:		5	5	5	6	5		9	5	6
FLA KING PATTERN OBVERSE:		1	1	1	1	1		0	1	1
FLA KING TYPE REVERSE:		6	5	5	5	5		6	5	5
FLAKING PATTERN REVERSE:		1	1	1	1	1		1	1	1
BLADE EDGE 1 SHAPE:		1	1		1	1		2	1	1
BLADE EDGE 1 MORPHOLOGY:		1	1		2	1		9	2	4
BLADE EDGE 2 SHAPE:		2	1		1	1	1	1	1	1
BLADE EDGE 2 MORPHOLOGY:		1	1		1	1	3	4	2	4
SHOULDER 1 SHAPE:										
SHOULDER 2 SHAPE:										
EDGE GRINDING:	9	9	9	9	9	9	9	9	9	9
BASE SHAPE:	3	2	1	2	1	1	9	1	1	1
BASAL THINNING:	3	6	3	6	6	5		1	6	4
NOTCH 1 SHAPE:										
NOTCH 1 ORIENTATION:										
NOTCH 2 SHAPE:										
NOTCH 2 ORIENTATION:										
NOTCHING TECHNIQUE:										
PROX.-LAT EDGE 1:										
PROX.-LAT EDGE 2:										
TIP MORPHOLOGY:		2				5		1	7	7
WEAR TYPE:										
WEAR LOCATION:										
HEAT TREATMENT:		6								
FIGURE REFERENCE:	44.e	44.j	44.k	44.a	43.q	43.f	43.c	44.n	44.l	43.d

(* = Incomplete)

TRIANGULAR

CATALOGUE NUMBER:	16197	16269	16492	16551	17376	17377	18717	21101	21190	22018
AREA:	2	2	2	2	2	2	2	2	2	2
UNIT:	4	4	4	4	4	4	21	6	6	4
QUADRANT; SUBQUAD.:	3,1	3,1	3,2	3,3	4,2	4,2	3,			
LEVEL:	1	2	2	1	1	1	1			2
DEPTH:										
CLASS:	5	5	5	3	5	5	5	5	5	5
RAW MATERIAL:	5	1	2	8	4	2	7	1	1	2
WEIGHT:	0.4	0.3*	0.5*	1.2	0.5	0.2*	0.7*	0.5*	0.4*	0.8*
MAXIMUM LENGTH:	15,8	11.2*	16.0*	19.3	13.7	5.5*	17.7	13.7*	12.1*	15.9*
MAXIMUM WIDTH:	9.5	11.5	11.9*	17.7	9.9	9.8	13.1*	12.1	10.7*	16.2
POS. MAX WIDTH:	2.8	2.2	0	4.5	3.7	0	7.2	2.5	0	2.7
MAXIMUM THICKNESS:	3.1	2.3	2.6	3.8	3.3	2.0	4.0	3.1	2.3	2.8
POS. MAX. THICKNESS:	4.6	3.8		2.8	3.5		7.1	6.8		4.9
BLADE LENGTH:										
STEM LENGTH:										
BLADE WIDTH:										
SHOULDER WIDTH:										
POS. SHOULDER WIDTH:										
NECK WIDTH:										
POS. NECK:										
STEM WIDTH:										
BASE WIDTH:	8.7	10.2		17.4	9.3	9.6	8.9*	9.4		15.7
BASAL NOTCH DEPTH:						0.7				
NOTCH 1 DEPTH:				9						
NOTCH 1 BREADTH:				4.0						
NOTCH 2 DEPTH:										
NOTCH 2 BREADTH:										
PROX.-LAT. EDGE 1 HT.										
PROX.-LAT. EDGE 2 HT.										
TIP ANGLE:	70			80			105			
BLADE ANGLE:	30	40		65			45	45		
EDGE 1 ANGLE:	60		60	65	70		55	55		
EDGE 2 ANGLE:	60			60	65		75	60		
INTEGRITY:	1	2	9	1	1	4	5	2	9	2
LONG. X SEC.:	2	8	2	8	2	2	4	1		
TRANS. X SEC.:	2	1	1	2	9		1	1	1	3
BLANK TYPE:				2			3			
BLANK ORIENTATION:										
FLA KING TYPE OBVERSE:	5	5	5	6	5		6	5	5	5
FLA KING PATTERN OBVERSE:	1	1	1	1	1		1	1	1	1
FLA KING TYPE REVERSE:	5	5	5	6	5		7	5	5	5
FLAKING PATTERN REVERSE:	1	1	1	1	1		3	1	1	1
BLADE EDGE 1 SHAPE:	1	1	1	2	2		2	3		1
BLADE EDGE 1 MORPHOLOGY:	1	1	2	4	1		5	2		1
BLADE EDGE 2 SHAPE:	2	1		1	7		2	1		1
BLADE EDGE 2 MORPHOLOGY:	1	1		4	9		1	1		1
SHOULDER 1 SHAPE:										
SHOULDER 2 SHAPE:										
EDGE GRINDING:	9	9	9	9	9	9	9	9	9	9
BASE SHAPE:	2	1	1	2	3	3	1	1	1	1
BASAL THINNING:	2	6	6	3	3	5	3	6	6	6
NOTCH 1 SHAPE:										
NOTCH 1 ORIENTATION:										
NOTCH 2 SHAPE:										
NOTCH 2 ORIENTATION:										
NOTCHING TECHNIQUE:										
PROX.-LAT EDGE 1:										
PROX.-LAT EDGE 2:										
TIP MORPHOLOGY:	1	7		2	3		1	7	9	7
WEAR TYPE:					1					
WEAR LOCATION:					5					
HEAT TREATMENT:		6					1		1	
FIGURE REFERENCE:	43.i	44.f	44.i	43.m	43.j	43.a	43.g	43.h	44.b	43.n

(* = Incomplete)

TRIANGULAR

CATALOGUE NUMBER:	11659	13201	13450	14833	14855	15031	15255	15368	15369	16189
AREA:	2	2	2	2	2	2	2	2	2	2
UNIT:	4	2	2	6	6	6	6	6	6	4
QUADRANT; SUBQUAD.:	2,3	3,4	4,1	1,4	1,3	1,4	1,4	1,4	1,4	3,1
LEVEL:	1	1	1	1	1	1	1	1	1	1
DEPTH:				2						
CLASS:	5	5	5	5	4	5	5	5	5	5
RAW MATERIAL:	12	1	1	1	1	7	1	1	1	7
WEIGHT:	0.4	0.5*	0.7*	1.4	0.3*	0.3*	0.7	0.4	0.5	0.9*
MAXIMUM LENGTH:	14.6	13.6*	21.4*	23.7	13.2	10.5*	22.3	14.4*	13.2	20.9
MAXIMUM WIDTH:	12.3	12.4	9.7*	14.2	8.9*	13.5	12.2	13.3	14.0	16.2*
POS. MAX WIDTH:	3.4	4.4	0	5.9	0	0	2.5	4.5	2.6	0
MAXIMUM THICKNESS:	2.6	2.6	3.8	4.7	2.6	2.4	2.9	2.1	2.9	3.0
POS. MAX. THICKNESS:	9.7	6.3		8.5			8.5	5.8	7.8	
BLADE LENGTH:										
STEM LENGTH:										
BLADE WIDTH:										
SHOULDER WIDTH:										
POS. SHOULDER WIDTH:										
NECK WIDTH:										
POS. NECK:										
STEM WIDTH:										
BASE WIDTH:	11.5	10.8		12.5		12.4	10.3	12.8	13.9	
BASAL NOTCH DEPTH:				0.5			0.4		0.4	
NOTCH 1 DEPTH:										
NOTCH 1 BREADTH:										
NOTCH 2 DEPTH:										
NOTCH 2 BREADTH:										
PROX.-LAT. EDGE 1 HT.										
PROX.-LAT. EDGE 2 HT.										
TIP ANGLE:	90			70	80		70			
BLADE ANGLE:					35		35		55	
EDGE 1 ANGLE:	55			65	65		40		60	45
EDGE 2 ANGLE:	65			60	55		40		60	
INTEGRITY:	1	2	8	1	5	4	1	2	1	5
LONG. X SEC.:	2	2		1	3		9	2	1	3
TRANS. X SEC.:	4	2		1	3		9	1	1	6
BLANK TYPE:	4	3		2	3	3				2
BLANK ORIENTATION:	1			7						
FLA KING TYPE OBVERSE:	6	6		5	6		5	5	5	6
FLA KING PATTERN OBVERSE:	1	1		1	1		1	1	1	1
FLA KING TYPE REVERSE:	6	5		5	6		5	5	5	6
FLAKING PATTERN REVERSE:	1	1		1	1		1	1	1	1
BLADE EDGE 1 SHAPE:	5		1	2	2		2		1	6
BLADE EDGE 1 MORPHOLOGY:	2		1	2	2		1		2	1
BLADE EDGE 2 SHAPE:	2			2	2		2		6	
BLADE EDGE 2 MORPHOLOGY:	2			2	4		1		2	2
SHOULDER 1 SHAPE:										
SHOULDER 2 SHAPE:										
EDGE GRINDING:	9	9	9	9	9	9	9	9	9	9
BASE SHAPE:	1	1		3	1	1	3	1	1	
BASAL THINNING:	1	2	5	5	2	2	6	6	5	6
NOTCH 1 SHAPE:										
NOTCH 1 ORIENTATION:										
NOTCH 2 SHAPE:										
NOTCH 2 ORIENTATION:										
NOTCHING TECHNIQUE:										
PROX.-LAT EDGE 1:										
PROX.-LAT EDGE 2:										
TIP MORPHOLOGY:	1			1	1		1		7	2
WEAR TYPE:										
WEAR LOCATION:										
HEAT TREATMENT:				4		5				
FIGURE REFERENCE:	43.1	44.g	44.h	43.p	44.m	43.b	43.k	44.d	43.e	43.o

(* = Incomplete)

TRIANGULAR

		MEAN	MIN	MAX
CATALOGUE NUMBER:				
AREA:				
UNIT:				
QUADRANT; SUBQUAD.:				
LEVEL:				
DEPTH:				
CLASS:				
RAW MATERIAL:				
WEIGHT:		0.7	0.3	1.4
MAXIMUM LENGTH:		16.8	13.2	23.7
MAXIMUM WIDTH:		12.3	8.9	17.7
POS. MAX WIDTH:		2.5	0	7.2
MAXIMUM THICKNESS:		2.9	2.0	4.7
POS. MAX. THICKNESS:		6.2	2.8	9.7
BLADE LENGTH:				
STEM LENGTH:				
BLADE WIDTH:				
SHOULDER WIDTH:				
POS. SHOULDER WIDTH:				
NECK WIDTH:				
POS. NECK:				
STEM WIDTH:				
BASE WIDTH:	11.0	6.8	17.4	
BASAL NOTCH DEPTH:	0.5	0.3	0.8	
NOTCH 1 DEPTH:				
NOTCH 1 BREADTH:				
NOTCH 2 DEPTH:				
NOTCH 2 BREADTH:				
PROX.-LAT. EDGE 1 HT.				
PROX.-LAT. EDGE 2 HT.				
TIP ANGLE:		78.7	65	105
BLADE ANGLE:		44	30	65
EDGE 1 ANGLE:	(1+2)	54.4	25	75
EDGE 2 ANGLE:				
INTEGRITY:				
LONG. X SEC.:				
TRANS. X SEC.:				
BLANK TYPE:				
BLANK ORIENTATION:				
FLAKING TYPE OBVERSE:				
FLAKING PATTERN OBVERSE:				
FLAKING TYPE REVERSE:				
FLAKING PATTERN REVERSE:				
BLADE EDGE 1 SHAPE:				
BLADE EDGE 1 MORPHOLOGY:				
BLADE EDGE 2 SHAPE:				
BLADE EDGE 2 MORPHOLOGY:				
SHOULDER 1 SHAPE:				
SHOULDER 2 SHAPE:				
EDGE GRINDING:				
BASE SHAPE:				
BASAL THINNING:				
NOTCH 1 SHAPE:				
NOTCH 1 ORIENTATION:				
NOTCH 2 SHAPE:				
NOTCH 2 ORIENTATION:				
NOTCHING TECHNIQUE:				
PROX.-LAT EDGE 1:				
PROX.-LAT EDGE 2:				
TIP MORPHOLOGY:				
WEAR TYPE:				
WEAR LOCATION:				
HEAT TREATMENT:				
FIGURE REFERENCE:				

(* = Incomplete)

	NORTHERN SIDE NOTCHED	BROAD V-SHAPED SIDE NOTCHED	FLAKE POINT	SIDE AND BLADE NOTCHED
CATALOGUE NUMBER:	2108	242	11621	12443
AREA:	2	1	2	2
UNIT:	999	5	4	2
QUADRANT; SUBQUAD.:		2,2	2,3	2,4
LEVEL:		2	1	1
DEPTH:				
CLASS:	5	5	1,3	5
RAW MATERIAL:	16	2	12	1
WEIGHT:	4.4	1.2	0.9	1.0
MAXIMUM LENGTH:	19.8	16.3	18.0	19.0
MAXIMUM WIDTH:	30.8	16.3	14.0	12.3
POS. MAX WIDTH:		10.4		
MAXIMUM THICKNESS:	6.6	4.6	3.3	4.8
POS. MAX. THICKNESS:		6.9		9.5
BLADE LENGTH:		6.4	7.8	
STEM LENGTH:		9.9		7.5
BLADE WIDTH:		16.0	11.0	
SHOULDER WIDTH:		16.3	11.0	
POS. SHOULDER WIDTH:		10.3		
NECK WIDTH:	24.9	13.2	10.3	7.0
POS. NECK:	16.7	6.8		4.3
STEM WIDTH:	30.7	15.6	14.0	
BASE WIDTH:	21.2	15.6		
BASAL NOTCH DEPTH:	2.1			
NOTCH 1 DEPTH:		1.8	1.1	1.8
NOTCH 1 BREADTH:		5.8	4.9	5.5
NOTCH 2 DEPTH:		1.5		
NOTCH 2 BREADTH:		7.3		
PROX.-LAT. EDGE 1 HT.	13.2			
PROX.-LAT. EDGE 2 HT.	13.3			
TIP ANGLE:		130	95	
BLADE ANGLE:		115		
STEM ANGLE:	40			
EDGE 1 ANGLE:		55	70	
EDGE 2 ANGLE:		65	80	
INTEGRITY:	4	1	1	2
LONG. X SEC.:		1	2	9
TRANS. X SEC.:		1	9	1
BLANK TYPE:		3	2	
BLANK ORIENTATION:			2	
FLA KING TYPE OBVERSE:		6	6	5
FLA KING PATTERN OBVERSE:		1	1	1
FLA KING TYPE REVERSE:		5	6	5
FLAKING PATTERN REVERSE:		3	1	1
BLADE EDGE 1 SHAPE:		1	1	9
BLADE EDGE 1 MORPHOLOGY:		3	2	9
BLADE EDGE 2 SHAPE:		1	5	9
BLADE EDGE 2 MORPHOLOGY:		3	2	9
SHOULDER 1 SHAPE:		1	1	3
SHOULDER 2 SHAPE:		3	4	1
EDGE GRINDING:	2	2	9	9
BASE SHAPE:	3	2	8	5
BASAL THINNING:	7	3	1	3
NOTCH 1 SHAPE:		4	4	3
NOTCH 1 ORIENTATION:		1	3	3
NOTCH 2 SHAPE:		4	6	3
NOTCH 2 ORIENTATION:		1	2	3
NOTCHING TECHNIQUE:	1	2	4	1
PROX.-LAT EDGE 1:	3	4	6	6
PROX.-LAT EDGE 2:	3	4	9	6
TIP MORPHOLOGY:		2	1	7
WEAR TYPE:				
WEAR LOCATION:				
HEAT TREATMENT:				
FIGURE REFERENCE:	42.a	38.1	39.1	38.n

(* = Incomplete)

	SMALL STEMMED		CONCAVE BASED LANCEOLATE	
CATALOGUE NUMBER:	6846	7932	1535	15563
AREA:	11	2	1	2
UNIT:	9	502	8	6
QUADRANT; SUBQUAD.:	4,2			2,1
LEVEL:		1	2	1
DEPTH:	20		17	
CLASS:	5	3	5	5
RAW MATERIAL:	4	2	1	6
WEIGHT:	0.3	0.2	1.9*	0.6*
MAXIMUM LENGTH:	15.3	15.4	14.5*	17.9*
MAXIMUM WIDTH:	8.2	7.5	21.3	12.4
POS. MAX WIDTH:	6.2	8.4		
MAXIMUM THICKNESS:	2.1	2.2	5.6	3.5
POS. MAX. THICKNESS:	4.8	6.2		
BLADE LENGTH:	9.7	12.1		
STEM LENGTH:	5.6	3.3		
BLADE WIDTH:		7.3		
SHOULDER WIDTH:	8.0	6.6		
POS. SHOULDER WIDTH:	5.6	3.3		
NECK WIDTH:				
POS. NECK:				
STEM WIDTH:	7.3	4.7		
BASE WIDTH:	6.6	3.8	18.2	
BASAL NOTCH DEPTH:			1.2	
NOTCH 1 DEPTH:				
NOTCH 1 BREADTH:				
NOTCH 2 DEPTH:				
NOTCH 2 BREADTH:				
PROX.-LAT. EDGE 1 HT.				
PROX.-LAT. EDGE 2 HT.				
TIP ANGLE:	80	60		
BLADE ANGLE:	50			
EDGE 1 ANGLE:	45	70		45
EDGE 2 ANGLE:	45	60		
INTEGRITY:	1	1	4	3
LONG. X SEC.:	8	4		
TRANS. X SEC.:	3	1	2	1
BLANK TYPE:	4	3		
BLANK ORIENTATION:				5
FLA KING TYPE OBVERSE:	5	6		5
FLA KING PATTERN OBVERSE:	1	1		1
FLA KING TYPE REVERSE:	6	9		5
FLAKING PATTERN REVERSE:	1	9		1
BLADE EDGE 1 SHAPE:	2	2		6
BLADE EDGE 1 MORPHOLOGY:	3	3		2
BLADE EDGE 2 SHAPE:	5	9		9
BLADE EDGE 2 MORPHOLOGY:	3	9		8
SHOULDER 1 SHAPE:	4	4	9	9
SHOULDER 2 SHAPE:	9	3	9	9
EDGE GRINDING:	9	9	9	9
BASE SHAPE:	2	2	3	5
BASAL THINNING:	6	1	8	4
NOTCH 1 SHAPE:	9	9	9	9
NOTCH 1 ORIENTATION:	9	9	9	9
NOTCH 2 SHAPE:	9	9	9	9
NOTCH 2 ORIENTATION:	9	9	9	9
NOTCHING TECHNIQUE:	9	9	9	9
PROX.-LAT EDGE 1:	4	4	9	9
PROX.-LAT EDGE 2:	6	6	9	9
TIP MORPHOLOGY:	1	1		9
WEAR TYPE:				
WEAR LOCATION:				
HEAT TREATMENT:			5	
FIGURE REFERENCE:	39.c	38.c	42.b	38.m

(* = Incomplete)

HANNA

CATALOGUE NUMBER:	2118	7829	7759
AREA:	2	12	11
UNIT:	999	504	11
QUADRANT; SUBQUAD.:			1,2
LEVEL:			2
DEPTH:		30	
CLASS:	5	3	5
RAW MATERIAL:	1	1	1
WEIGHT:	1.3*	0.5*	1.1*
MAXIMUM LENGTH:	12.6*	12.3*	12.6*
MAXIMUM WIDTH:	21.7*	15.6	17.1*
POS. MAX WIDTH:			
MAXIMUM THICKNESS:	4.7*	2.4	5.0
POS. MAX. THICKNESS:			
BLADE LENGTH:			
STEM LENGTH:			
BLADE WIDTH:			
SHOULDER WIDTH:			
POS. SHOULDER WIDTH:			
NECK WIDTH:		12.2	12.8
POS. NECK:		5.8	6.7
STEM WIDTH:		15.3	
BASE WIDTH:		13.0	
BASAL NOTCH DEPTH:		0.9	
NOTCH 1 DEPTH:		1.8	
NOTCH 1 BREADTH:		5.5	
NOTCH 2 DEPTH:			
NOTCH 2 BREADTH:			
PROX.-LAT. EDGE 1 HT.		2.9	
PROX.-LAT. EDGE 2 HT.			
TIP ANGLE:			
BLADE ANGLE:			
EDGE 1 ANGLE:			
EDGE 2 ANGLE:			
INTEGRITY:	4	3	3
LONG. X SEC.:			
TRANS. X SEC.:			1
BLANK TYPE:		2	
BLANK ORIENTATION:		1	
FLA KING TYPE OBVERSE:			
FLA KING PATTERN OBVER			
FLA KING TYPE REVERSE:			
FLAKING PATTERN REVERS			
BLADE EDGE 1 SHAPE:			
BLADE EDGE 1 MORPHOLOG			
BLADE EDGE 2 SHAPE:			
BLADE EDGE 2 MORPHOLOG			
SHOULDER 1 SHAPE:			
SHOULDER 2 SHAPE:			
EDGE GRINDING:	2	5	2
BASE SHAPE:	1	3	3
BASAL THINNING:	5	3	6
NOTCH 1 SHAPE:	7		
NOTCH 1 ORIENTATION:			
NOTCH 2 SHAPE:			
NOTCH 2 ORIENTATION:			
NOTCHING TECHNIQUE:	4	4	
PROX.-LAT EDGE 1:	7	7	
PROX.-LAT EDGE 2:		7	7
TIP MORPHOLOGY:			
WEAR TYPE:			
WEAR LOCATION:			
HEAT TREATMENT:			
FIGURE REFERENCE:	42.e	38.j	38.i

(* = Incomplete)

	CORNER NOTCHED		NOTCHLESS EARNED	
CATALOGUE NUMBER:	2116	10382	7844	14832
AREA:	2	2	12	2
UNIT:	999	999	2	6
QUADRANT; SUBQUAD.:			4,3	1,4
LEVEL:			2	1
DEPTH:				5
CLASS:	5	5	5	5
RAW MATERIAL:	4	3	3	3
WEIGHT:	0.6	1.5	0.9	0.5
MAXIMUM LENGTH:	19.6	18.5	14.7	14.4
MAXIMUM WIDTH:	11.9	17.9	12.9	12.7
POS. MAX WIDTH:		9.6		2.3
MAXIMUM THICKNESS:	3.2	4.6	4.2	2.8
POS. MAX. THICKNESS:		4.6		6.4
BLADE LENGTH:				8.7
STEM LENGTH:	7.6	6.0		5.4
BLADE WIDTH:		17.9		9.6
SHOULDER WIDTH:		17.6		
POS. SHOULDER WIDTH:	7.5	6.8		
NECK WIDTH:	6.4	9.8		9.5
POS. NECK:	5.1	3.7		4.1
STEM WIDTH:				12.5
BASE WIDTH:				11.3
BASAL NOTCH DEPTH:				
NOTCH 1 DEPTH:				
NOTCH 1 BREADTH:				
NOTCH 2 DEPTH:		2.1		0.4
NOTCH 2 BREADTH:		7.1		1.3
PROX.-LAT. EDGE 1 HT.			3.9	2.2
PROX.-LAT. EDGE 2 HT.				
TIP ANGLE:				100
BLADE ANGLE:	40	50		
EDGE 1 ANGLE:				65
EDGE 2 ANGLE:	60			75
INTEGRITY:	9	6	9	1
LONG. X SEC.:	1	3	2	2
TRANS. X SEC.:	5	1	1	2
BLANK TYPE:	2			
BLANK ORIENTATION:				
FLA KING TYPE OBVERSE:	6	5	5	6
FLA KING PATTERN OBVERSE:	1	1	1	1
FLA KING TYPE REVERSE:	6	5	5	5
FLAKING PATTERN REVERSE:	1	1	1	1
BLADE EDGE 1 SHAPE:	1	1	1	2
BLADE EDGE 1 MORPHOLOGY:	8	1	2	1
BLADE EDGE 2 SHAPE:	1	1	1	6
BLADE EDGE 2 MORPHOLOGY:	4	1	2	9
SHOULDER 1 SHAPE:		5	9	9
SHOULDER 2 SHAPE:	5	1	9	9
EDGE GRINDING:	9		5	5
BASE SHAPE:	2		3	1
BASAL THINNING:	3			5
NOTCH 1 SHAPE:			9	9
NOTCH 1 ORIENTATION:	3		9	9
NOTCH 2 SHAPE:			9	6
NOTCH 2 ORIENTATION:	3		9	1
NOTCHING TECHNIQUE:	3	5	9	8
PROX.-LAT EDGE 1:	6		3	1
PROX.-LAT EDGE 2:				4
TIP MORPHOLOGY:	7	5		1
WEAR TYPE:				
WEAR LOCATION:				
HEAT TREATMENT:				
FIGURE REFERENCE:	39.k	42.d	38.g	39.e

(* = Incomplete)

POINT FRAGMENTS: BASES

CATALOGUE NUMBER:	76	1936	2107	6584	8645	8666	9002	9003	9819	9940
AREA:	1	1	1	11	2	2	2	2	2	2
UNIT:	3	10	999	9	1	1	1	1	2	2
QUADRANT; SUBQUAD.:	3,2			2,2	1,4	1,4	2,2	2,2	2,1	2,2
LEVEL:	2	1		1	1	2	1	1	1	1
DEPTH:										
CLASS:	5	5	5	5	5	3	5	5	5	5
RAW MATERIAL:	7	7	1	1	7	7	1	1	2	1
WEIGHT:	0.2	0.3	0.3	0.4	0.5	0.3	0.2	0.3	0.3	0.4
MAXIMUM LENGTH:	6.2	5.9	7.4	9.5	8.8	8.1	7.6	8.7	7.1	7.8
MAXIMUM WIDTH:	11.2	9.4	11.3	11.1	15.3	14.0	9.5	11.7	13.8	16.7
POS. MAX WIDTH:	2.7	2.8	3.3	3.1	3.0	2.6	3.6	2.7	1.3	3.3
MAXIMUM THICKNESS:										
POS. MAX. THICKNESS:										
BLADE LENGTH:										
STEM LENGTH:										
BLADE WIDTH:										
SHOULDER WIDTH:										
POS. SHOULDER WIDTH:										
NECK WIDTH:		6.3		7.3	11.0	11.4		8.4	8.9	
POS. NECK:	3.6		4.7	5.8	2.9		5.1	6.0		
STEM WIDTH:	11.2	9.4		11.1	15.3	12.6				
BASE WIDTH:	9.7	8.4		10.5	14.8	12.6				
BASAL NOTCH DEPTH:										
NOTCH 1 DEPTH:							1.5			
NOTCH 1 BREADTH:							3.7			
NOTCH 2 DEPTH:										
NOTCH 2 BREADTH:										
PROX.-LAT. EDGE 1 HT.		4.0		1.8					5.1	
PROX.-LAT. EDGE 2 HT.	2.6									
TIP ANGLE:										
BLADE ANGLE:										
EDGE 1 ANGLE:										
EDGE 2 ANGLE:										
INTEGRITY:	4	4	4	4	4	4	3	4	4	
LONG. X SEC.:										
TRANS. X SEC.:										
BLANK TYPE:						3			8	
BLANK ORIENTATION:										
FLAKING TYPE OBVERSE:										
FLAKING PATTERN OBVERSE:										
FLAKING TYPE REVERSE:										
FLAKING PATTERN REVERSE:										
BLADE EDGE 1 SHAPE:										
BLADE EDGE 1 MORPHOLOGY:										
BLADE EDGE 2 SHAPE:										
BLADE EDGE 2 MORPHOLOGY:										
SHOULDER 1 SHAPE:								1		
SHOULDER 2 SHAPE:										
EDGE GRINDING:	8	9	9	7	7	5		9	1	2
BASE SHAPE:	1	2	1	2	2	2		1	1	
BASAL THINNING:	2	2	6	3	3	3		3	3	
NOTCH 1 SHAPE:								3		
NOTCH 1 ORIENTATION:								1		
NOTCH 2 SHAPE:										
NOTCH 2 ORIENTATION:										
NOTCHING TECHNIQUE:		1				1		4	3	
PROX.-LAT EDGE 1:	6	1	1	7	3	4			1	
PROX.-LAT EDGE 2:	1	9		6	7	5	6	1		
TIP MORPHOLOGY:										
WEAR TYPE:										
WEAR LOCATION:										
HEAT TREATMENT:										
FIGURE REFERENCE:	45.h	45.m	46.ff	46.dd	42.j	45.v	46.r	45.w	46.y	46.gg

(* = Incomplete)

POINT FRAGMENTS: BASES

CATALOGUE NUMBER:	11771	13003	13098	13234	16407	16639	16911	17335	17428	17593
AREA:	2	2	2	2	2	2	2	2	2	2
UNIT:	4	2	2	2	4	4	4	4	4	4
QUADRANT; SUBQUAD.:	2,4	3,3	3,4	4,1	3,2	3,3	3,4	4,2	4,2	4,3
LEVEL:	1	1	1	1	1	1	1	1	1	1
DEPTH:										
CLASS:	5	3	5	5	3	5	5	5	5	5
RAW MATERIAL:	6	2	3	1	6	1	1	2	2	16
WEIGHT:	0.2	0.1	0.6	0.2	0.1	0.3	0.2	0.2	0.3	0.4
MAXIMUM LENGTH:	6.2	6.7	8.7	8.9	7.6	8.3	6.9	6.7	5.8	7.3
MAXIMUM WIDTH:	10.8	11.0	16.0	11.6	8.0	13.1	10.5	10.8	15.3	15.2
POS. MAX WIDTH:										
MAXIMUM THICKNESS:	2.6	2.3	4.2	2.4	1.8	2.5	2.3	2.7	3.0	3.4
POS. MAX. THICKNESS:										
BLADE LENGTH:										
STEM LENGTH:										
BLADE WIDTH:										
SHOULDER WIDTH:										
POS. SHOULDER WIDTH:										
NECK WIDTH:			12.7		9.4	7.0		9.9		
POS. NECK:			5.8		5.8	4.0		5.6		
STEM WIDTH:					13.1	10.5	10.8	15.2	15.0	
BASE WIDTH:					11.0	9.7		13.8	15.0	
BASAL NOTCH DEPTH:						0.3				
NOTCH 1 DEPTH:										
NOTCH 1 BREADTH:										
NOTCH 2 DEPTH:										
NOTCH 2 BREADTH:										
PROX.-LAT. EDGE 1 HT.						3.0	3.7	2.8	3.8	
PROX.-LAT. EDGE 2 HT.	4.8							2.3	1.9	
TIP ANGLE:										
BLADE ANGLE:										
EDGE 1 ANGLE:										
EDGE 2 ANGLE:										
INTEGRITY:	4	4	4	4	4	4	4	4	4	
LONG. X SEC.:										
TRANS. X SEC.:										
BLANK TYPE:							4			
BLANK ORIENTATION:										
FLA KING TYPE OBVERSE:										
FLA KING PATTERN OBVERSE:										
FLA KING TYPE REVERSE:										
FLAKING PATTERN REVERSE:										
BLADE EDGE 1 SHAPE:										
BLADE EDGE 1 MORPHOLOGY:										
BLADE EDGE 2 SHAPE:										
BLADE EDGE 2 MORPHOLOGY:										
SHOULDER 1 SHAPE:										
SHOULDER 2 SHAPE:										
EDGE GRINDING:	5	9	1	9		9	2	2	7	6
BASE SHAPE:			2	1		1	1	3	1	1
BASAL THINNING:	3		7			3	3	3	6	3
NOTCH 1 SHAPE:										
NOTCH 1 ORIENTATION:										
NOTCH 2 SHAPE:										
NOTCH 2 ORIENTATION:										
NOTCHING TECHNIQUE:			3				1	1	3	1
PROX.-LAT EDGE 1:			5		7	6	2	1	3	2
PROX.-LAT EDGE 2:	1					6	6		8	3
TIP MORPHOLOGY:										
WEAR TYPE:										
WEAR LOCATION:										
HEAT TREATMENT:										
FIGURE REFERENCE:	46.cc	46.aa	42.k		45.q	46.bb	45.j	46.z	45.n	45.i

(* = Incomplete)

POINT FRAGMENTS: BASES

CATALOGUE NUMBER:	18719	19021	22016
AREA:	2	2	2
UNIT:	21	21	4
QUADRANT; SUBQUAD.:	3	4	
LEVEL:	1	1	2
DEPTH:			
CLASS:	5	4	5
RAW MATERIAL:	14	12	2
WEIGHT:	1.1	0.2	1.0
MAXIMUM LENGTH:	13.2	7.3	6.1
MAXIMUM WIDTH:	15.7	9.2	9.4
POS. MAX WIDTH:			
MAXIMUM THICKNESS:	4.4	2.3	1.8
POS. MAX. THICKNESS:			
BLADE LENGTH:			
STEM LENGTH:			
BLADE WIDTH:			
SHOULDER WIDTH:			9.3
POS. SHOULDER WIDTH:			4.8
NECK WIDTH:		7.0	6.6
POS. NECK:			3.3
STEM WIDTH:			8.1
BASE WIDTH:	9.5		8.1
BASAL NOTCH DEPTH:			
NOTCH 1 DEPTH:			1.2
NOTCH 1 BREADTH:			3.3
NOTCH 2 DEPTH:			1.4
NOTCH 2 BREADTH:			2.9
PROX.-LAT. EDGE 1 HT.			
PROX.-LAT. EDGE 2 HT.			
TIP ANGLE:			
BLADE ANGLE:			
EDGE 1 ANGLE:			
EDGE 2 ANGLE:			
INTEGRITY:	4	4	4
LONG. X SEC.:			
TRANS. X SEC.:	1		
BLANK TYPE:		2	2
BLANK ORIENTATION:		1	3
FLA KING TYPE OBVERSE:			
FLA KING PATTERN OBVERSE:			
FLA KING TYPE REVERSE:			
FLAKING PATTERN REVERSE:			
BLADE EDGE 1 SHAPE:			
BLADE EDGE 1 MORPHOLOGY:			
BLADE EDGE 2 SHAPE:			
BLADE EDGE 2 MORPHOLOGY:			
SHOULDER 1 SHAPE:		3	3
SHOULDER 2 SHAPE:		3	2
EDGE GRINDING:	9	9	9
BASE SHAPE:	1	8	1
BASAL THINNING:		2	3
NOTCH 1 SHAPE:	9	6	4
NOTCH 1 ORIENTATION:	9	1	1
NOTCH 2 SHAPE:	9	7	7
NOTCH 2 ORIENTATION:	9	1	2
NOTCHING TECHNIQUE:	9	3	2
PROX.-LAT EDGE 1:	9	9	4
PROX.-LAT EDGE 2:	9	3	4
TIP MORPHOLOGY:			
WEAR TYPE:			
WEAR LOCATION:			
HEAT TREATMENT:			
FIGURE REFERENCE:	45.z	45.k	45.1

(* = Incomplete)

POINT FRAGMENTS: TIPS

CATALOGUE NUMBER:	1326	1536	5121	6455	6699	7677	8834	10931	11002	11858
AREA:	1	1	2	11	11	11	2	2	2	2
UNIT:	8	8	4	9	9	9	1	4	4	2
QUADRANT; SUBQUAD.:			3,1	1,3	3,1	4,	2,1	1,3	1,3	2,4
LEVEL:	1	2	1	1	1	2	1	1	1	1
DEPTH:		16								
CLASS:	5	5	5	3	5	5	5	5	5	5
RAW MATERIAL:	2	2	3	16	2	2	4	1	1	1
WEIGHT:	0.1	0.2	0.7	0.2	0.5	0.2	0.2	0.2	0.2	0.3
MAXIMUM LENGTH:	5.9	12.0	19.2	12.8	17.3	10.3	8.7	10.0	10.1	11.9
MAXIMUM WIDTH:	5.3	9.9	13.1	9.2	12.9	9.2	10.5	10.1	9.5	11.1
POS. MAX WIDTH:										
MAXIMUM THICKNESS:	1.7	2.6	3.2	1.8	2.0	2.2	2.6	1.8	1.5	2.7
POS. MAX. THICKNESS:										
BLADE LENGTH:										
STEM LENGTH:										
BLADE WIDTH:										
SHOULDER WIDTH:										
POS. SHOULDER WIDTH:										
NECK WIDTH:										
POS. NECK:										
STEM WIDTH:										
BASE WIDTH:										
BASAL NOTCH DEPTH:										
NOTCH 1 DEPTH:										
NOTCH 1 BREADTH:										
NOTCH 2 DEPTH:										
NOTCH 2 BREADTH:										
PROX.-LAT. EDGE 1 HT.										
PROX.-LAT. EDGE 2 HT.										
TIP ANGLE:	40	55	70	90	110		90	80		90
BLADE ANGLE:			50							
EDGE 1 ANGLE:			45		60					
EDGE 2 ANGLE:			45		50					
INTEGRITY:	7	7	7	7	7	7	7	7	7	7
LONG. X SEC.:			9		2				2	
TRANS. X SEC.:	1	1	1					1	3	
BLANK TYPE:				2	2					
BLANK ORIENTATION:				4						
FLA KING TYPE OBVERSE:			5	5	6	5				5
FLA KING PATTERN OBVERSE:			1	1	1	4				1
FLA KING TYPE REVERSE:			5	5	6	5			5	5
FLAKING PATTERN REVERSE:			1	1	1	1			3	1
BLADE EDGE 1 SHAPE:			2		2					
BLADE EDGE 1 MORPHOLOGY:			3		1					2
BLADE EDGE 2 SHAPE:			9		2					
BLADE EDGE 2 MORPHOLOGY:			9		1					1
SHOULDER 1 SHAPE:										
SHOULDER 2 SHAPE:										
EDGE GRINDING:										
BASE SHAPE:										
BASAL THINNING:										
NOTCH 1 SHAPE:										
NOTCH 1 ORIENTATION:										
NOTCH 2 SHAPE:										
NOTCH 2 ORIENTATION:										
NOTCHING TECHNIQUE:										
PROX.-LAT EDGE 1:										
PROX.-LAT EDGE 2:										
TIP MORPHOLOGY:	1	1	1	1	2	1	1	1	7	1
WEAR TYPE:										
WEAR LOCATION:										
HEAT TREATMENT:										
FIGURE REFERENCE:		46.i	46.d	45.d	45.b	46.o	45.e	45.c	45.f	46.p

* = Incomplete)

POINT FRAGMENTS: TIPS

CATALOGUE NUMBER:	11921	11977	13559	13880	15961	18747	20354
AREA:	2	2	2	2	2	2	12
UNIT:	4	4	2	2	6	21	9
QUADRANT; SUBQUAD.:	2,4	2,4	4,2	4,4	2,3	3,	9
LEVEL:	1	2	1	1	1	1	2
DEPTH:							
CLASS:	5	5	5	5	5	5	5
RAW MATERIAL:	2	6	2	1	1	2	2
WEIGHT:	0.2	0.6	0.1	0.3	0.1	0.2	0.1
MAXIMUM LENGTH:	10.5	14.4	8.8	11.7	6.3	9.3	9.9
MAXIMUM WIDTH:	11.7	12.9	7.8	11.2	7.1	9.3	7.7
POS. MAX WIDTH:							
MAXIMUM THICKNESS:	2.1	3.6	2.4	1.9	1.8	2.1	2.3
POS. MAX. THICKNESS:							
BLADE LENGTH:							
STEM LENGTH:							
BLADE WIDTH:							
SHOULDER WIDTH:							
POS. SHOULDER WIDTH:							
NECK WIDTH:							
POS. NECK:							
STEM WIDTH:							
BASE WIDTH:							
BASAL NOTCH DEPTH:							
NOTCH 1 DEPTH:							
NOTCH 1 BREADTH:							
NOTCH 2 DEPTH:							
NOTCH 2 BREADTH:							
PROX.-LAT. EDGE 1 HT.							
PROX.-LAT. EDGE 2 HT.							
TIP ANGLE:	65		70	80	55	90	60
BLADE ANGLE:							
EDGE 1 ANGLE:		55					
EDGE 2 ANGLE:							
INTEGRITY:	7	7	7	7	7	7	7
LONG. X SEC.:				2			
TRANS. X SEC.:	1	1	1	2	5	1	
BLANK TYPE:		4					
BLANK ORIENTATION:							
FLA KING TYPE OBVERSE:	5	5					
FLA KING PATTERN OBVERSE:	1	1					
FLA KING TYPE REVERSE:	1	1	1	2			
FLAKING PATTERN REVERSE:	1	2	1	1			
BLADE EDGE 1 SHAPE:	1	1	1	2			
BLADE EDGE 1 MORPHOLOGY:	2	9	1	1			
BLADE EDGE 2 SHAPE:							
BLADE EDGE 2 MORPHOLOGY:							
SHOULDER 1 SHAPE:							
SHOULDER 2 SHAPE:							
EDGE GRINDING:							
BASE SHAPE:							
BASAL THINNING:							
NOTCH 1 SHAPE:							
NOTCH 1 ORIENTATION:							
NOTCH 2 SHAPE:							
NOTCH 2 ORIENTATION:							
NOTCHING TECHNIQUE:							
PROX.-LAT EDGE 1:							
PROX.-LAT EDGE 2:							
TIP MORPHOLOGY:	1	1	1	1	1	1	1
WEAR TYPE:							
WEAR LOCATION:							
HEAT TREATMENT:							
FIGURE REFERENCE:	46.j	45.g	46.n	46.k	46.h	46.m	46.l

(* = Incomplete)

POINT FRAGMENTS: MIDSECTIONS

CATALOGUE NUMBER:	1937	2125	7725	7728	11751	14079	15365	16253
AREA:	1	2	11	11	2	2	2	2
UNIT:	10	999	10	10	4	3	6	4
QUADRANT; SUBQUAD.:			1,1	1,3	2,3	2,4	1,4	3,1
LEVEL:	1		2	2	2	1	1	1
DEPTH:								
CLASS:	5	5	5	5	5	5	5	5
RAW MATERIAL:	2	1	1	6	16	1	1	7
WEIGHT:	0.2	0.2	0.3	0.9	0.3	2.9	0.5	1
MAXIMUM LENGTH:	6.5	16.6	12.9	11.6	11.2	22.2	13.0	
MAXIMUM WIDTH:	12.3	21.8	10.4	16.6	12.6	19.9	13.3	
POS. MAX WIDTH:								
MAXIMUM THICKNESS:	2.3	4.7	2.2	4.0	1.9	5.6	2.8	
POS. MAX. THICKNESS:								
BLADE LENGTH:								
STEM LENGTH:								
BLADE WIDTH:								
SHOULDER WIDTH:						19.8		
POS. SHOULDER WIDTH:								
NECK WIDTH:						13.9		
POS. NECK:								
STEM WIDTH:								
BASE WIDTH:								
BASAL NOTCH DEPTH:								
NOTCH 1 DEPTH:								
NOTCH 1 BREADTH:								
NOTCH 2 DEPTH:								
NOTCH 2 BREADTH:								
PROX.-LAT. EDGE 1 HT.								
PROX.-LAT. EDGE 2 HT.								
TIP ANGLE:								
BLADE ANGLE:			35		35			
EDGE 1 ANGLE:								
EDGE 2 ANGLE:			30			4		
INTEGRITY:	6	6	6	6	6	6	6	8
LONG. X SEC.:			2	2				
TRANS. X SEC.:	1	3	1		3	1	1	
BLANK TYPE:		3			3			
BLANK ORIENTATION:								
FLA KING TYPE OBVERSE:		6	5	5	6			
FLA KING PATTERN OBVERSE:		1	1	1	1			
FLA KING TYPE REVERSE:		1	1	5	5			
FLAKING PATTERN REVERSE:		4	2	1	1			
BLADE EDGE 1 SHAPE:		2		1				
BLADE EDGE 1 MORPHOLOGY:		1		1	1			
BLADE EDGE 2 SHAPE:		1	1					
BLADE EDGE 2 MORPHOLOGY:		1	1	4				
SHOULDER 1 SHAPE:		3				3		
SHOULDER 2 SHAPE:		3				3		
EDGE GRINDING:								
BASE SHAPE:								
BASAL THINNING:						8		
NOTCH 1 SHAPE:								
NOTCH 1 ORIENTATION:								
NOTCH 2 SHAPE:								
NOTCH 2 ORIENTATION:								
NOTCHING TECHNIQUE:						1		
PROX.-LAT EDGE 1:								
PROX.-LAT EDGE 2:								
TIP MORPHOLOGY:	4		4					
WEAR TYPE:								
WEAR LOCATION:								
HEAT TREATMENT:								4
FIGURE REFERENCE:	46.g	42.1	46.e	45.o	46.f	42.i	46.s	45.r

(* = Incomplete)

POINT FRAGMENTS: LATERAL SEGMENTS

CATALOGUE NUMBER:	11770	14955	16638	17060	18615	19023
AREA:	2	2	2	2	2	2
UNIT:	4	6	4	4	21	1
QUADRANT; SUBQUAD.:	2,4	1,3	3,3	4,3	2,	1,2
LEVEL:	1	1	1	2	2	1
DEPTH:						
CLASS:	5	5	3	5	5	5
RAW MATERIAL:						
WEIGHT:	0.3	0.2	0.4	0.3	0.3	0.2
MAXIMUM LENGTH:	11.4	9.3	15.7	13.0	14.9	13.4
MAXIMUM WIDTH:	7.1	7.3	7.9	11.0	6.4	10.4
POS. MAX WIDTH:						
MAXIMUM THICKNESS:	2.3	2.7	3.4	2.6	2.8	1.8
POS. MAX. THICKNESS:						
BLADE LENGTH:						
STEM LENGTH:						
BLADE WIDTH:						
SHOULDER WIDTH:						
POS. SHOULDER WIDTH:						
NECK WIDTH:						
POS. NECK:						
STEM WIDTH:						
BASE WIDTH:						
BASAL NOTCH DEPTH:						
NOTCH 1 DEPTH:			1.6	1.9		
NOTCH 1 BREADTH:			4.8	4.9		
NOTCH 2 DEPTH:	1.4					
NOTCH 2 BREADTH:	2.1					
PROX.-LAT. EDGE 1 HT.						
PROX.-LAT. EDGE 2 HT.				2.4		
TIP ANGLE:						
BLADE ANGLE:						
EDGE 1 ANGLE:			60			40
EDGE 2 ANGLE:						
INTEGRITY:	8	8	8	8	8	8
LONG. X SEC.:	2		9			
TRANS. X SEC.:						
BLANK TYPE:	3					1
BLANK ORIENTATION:						
FLA KING TYPE OBVERSE:			9			
FLA KING PATTERN OBVERSE:			9			
FLA KING TYPE REVERSE:			6			
FLAKING PATTERN REVERSE:			1		1	
BLADE EDGE 1 SHAPE:						
BLADE EDGE 1 MORPHOLOGY:			4		1	1
BLADE EDGE 2 SHAPE:						
BLADE EDGE 2 MORPHOLOGY:						
SHOULDER 1 SHAPE:			1			
SHOULDER 2 SHAPE:	1			3		
EDGE GRINDING:			9	7		
BASE SHAPE:				3		
BASAL THINNING:				5		
NOTCH 1 SHAPE:			4			
NOTCH 1 ORIENTATION:			3			
NOTCH 2 SHAPE:	2			4		
NOTCH 2 ORIENTATION:				1		
NOTCHING TECHNIQUE:						
PROX.-LAT EDGE 1:			6			
PROX.-LAT EDGE 2:				7		
TIP MORPHOLOGY:						
WEAR TYPE:						
WEAR LOCATION:						
HEAT TREATMENT:			1	7		
FIGURE REFERENCE:	45.s			46.v		46.g

(* = Incomplete)

POINT FRAGMENTS: BLADES

CATALOGUE NUMBER:	2119	10930	11003	14490	14078
AREA:	2	2	2	2	2
UNIT:	999	4	4	5	3
QUADRANT; SUBQUAD.:		1,3	1,3	2,2	2,3
LEVEL:		1	2	1	1
DEPTH:		7			
CLASS:	5	5	5	5	3
RAW MATERIAL:	1	2	2	8	1
WEIGHT:	0.9	0.4	0.3	1.7	0.9
MAXIMUM LENGTH:	17.8	16.8	17.0	18.4	18.3
MAXIMUM WIDTH:	14.4	10.6	12.0	17.7	16.4
POS. MAX WIDTH:					1.1
MAXIMUM THICKNESS:	3.9	2.6	1.9	4.9	
POS. MAX. THICKNESS:					
BLADE LENGTH:	8.3			16.1	
STEM LENGTH:					
BLADE WIDTH:	13.8			17.7	
SHOULDER WIDTH:	14.2				
POS. SHOULDER WIDTH:					
NECK WIDTH:	9.8				
POS. NECK:					
STEM WIDTH:					
BASE WIDTH:					15.1
BASAL NOTCH DEPTH:					
NOTCH 1 DEPTH:					
NOTCH 1 BREADTH:					
NOTCH 2 DEPTH:					
NOTCH 2 BREADTH:					
PROX.-LAT. EDGE 1 HT.					
PROX.-LAT. EDGE 2 HT.					
TIP ANGLE:	110	90	75		100
BLADE ANGLE:	90	40			
EDGE 1 ANGLE:	65	55	35	70	55
EDGE 2 ANGLE:	60	60	40	65	50
INTEGRITY:	5	5	5	5	5
LONG. X SEC.:	3	1	2		
TRANS. X SEC.:	3	1	1	1	
BLANK TYPE:			3		3
BLANK ORIENTATION:					
FLA KING TYPE OBVERSE:	5	5	5	5	6
FLA KING PATTERN OBVERSE:	1	1	1	1	1
FLA KING TYPE REVERSE:	5	5	5	5	5
FLAKING PATTERN REVERSE:	3	1	1	1	1
BLADE EDGE 1 SHAPE:	1	2	2	1	2
BLADE EDGE 1 MORPHOLOGY:	1		1	2	1
BLADE EDGE 2 SHAPE:	1	2	2	7	2
BLADE EDGE 2 MORPHOLOGY:	1	1	1	2	1
SHOULDER 1 SHAPE:	8				3
SHOULDER 2 SHAPE:	8			5	
EDGE GRINDING:					
BASE SHAPE:					
BASAL THINNING:					
NOTCH 1 SHAPE:					
NOTCH 1 ORIENTATION:					
NOTCH 2 SHAPE:					
NOTCH 2 ORIENTATION:					
NOTCHING TECHNIQUE:	2				
PROX.-LAT EDGE 1:					
PROX.-LAT EDGE 2:					
TIP MORPHOLOGY:	1	1	7	1	2
WEAR TYPE:					
WEAR LOCATION:					
HEAT TREATMENT:			3		4
FIGURE REFERENCE:	38.d	46.c	45.a	46.a	46.b

(* = Incomplete)

POINT FRAGMENTS: MISSING TIP AND PART OF BASE

CATALOGUE NUMBER:	2111	2113	2117	11923
AREA:	2	2	2	2
UNIT:	999	999	999	4
QUADRANT; SUBQUAD.:				2,4
LEVEL:				1
DEPTH:	5			
CLASS:	5	5	5	5
RAW MATERIAL:	1	1	2	1
WEIGHT:	0.7	0.8	0.7	0.2
MAXIMUM LENGTH:	16.6	15.1	12.8	9.6
MAXIMUM WIDTH:	12.4	12.3	16.3	11.7
POS. MAX WIDTH:		3.2		
MAXIMUM THICKNESS:	3.7	3.4	3.3	3.0
POS. MAX. THICKNESS:		9.1		
BLADE LENGTH:				
STEM LENGTH:	6.7		6.9	
BLADE WIDTH:				
SHOULDER WIDTH:		12.2	15.7	
POS. SHOULDER WIDTH:	7.6		7.2	
NECK WIDTH:		10.4	9.1	
POS. NECK:	6.0		5.1	
STEM WIDTH:				
BASE WIDTH:				
BASAL NOTCH DEPTH:				
NOTCH 1 DEPTH:	1.5		3.3	
NOTCH 1 BREADTH:	2.4		3.8	
NOTCH 2 DEPTH:				
NOTCH 2 BREADTH:				
PROX.-LAT. EDGE 1 HT.	5.2		3.0	
PROX.-LAT. EDGE 2 HT.				
TIP ANGLE:				
BLADE ANGLE:		20		
EDGE 1 ANGLE:				
EDGE 2 ANGLE:				
INTEGRITY:	9	9	9	9
LONG. X SEC.:	9			
TRANS. X SEC.:	9	1		
BLANK TYPE:	1		5	
BLANK ORIENTATION:				
FLA KING TYPE OBVERSE:	6	5	5	
FLA KING PATTERN OBVERSE:	1	1	1	
FLA KING TYPE REVERSE:	5	5	5	
FLAKING PATTERN REVERSE:	1	1	1	
BLADE EDGE 1 SHAPE:	1	1		
BLADE EDGE 1 MORPHOLOGY:	4	2		
BLADE EDGE 2 SHAPE:	2	5		
BLADE EDGE 2 MORPHOLOGY:	3	2		
SHOULDER 1 SHAPE:		4	1	4
SHOULDER 2 SHAPE:	4	1	4	
EDGE GRINDING:		9	5	
BASE SHAPE:		1		
BASAL THINNING:	3	3	3	
NOTCH 1 SHAPE:	7		7	
NOTCH 1 ORIENTATION:	1		2	
NOTCH 2 SHAPE:				
NOTCH 2 ORIENTATION:				
NOTCHING TECHNIQUE:		5	3	3
PROX.-LAT EDGE 1:	2		1	
PROX.-LAT EDGE 2:				
TIP MORPHOLOGY:	7	7		
WEAR TYPE:				
WEAR LOCATION:				
HEAT TREATMENT:				
FIGURE REFERENCE:	38.p	44.c	37.m	46.t

(* = Incomplete)

	NON-DIAGNOSTIC		NO TIPS	
CATALOGUE NUMBER:	249	3603	2109	9954
AREA:	1	11	2	2
UNIT:	6	529	999	2
QUADRANT; SUBQUAD.:				2.2
LEVEL:	11		1	
DEPTH:	3			
CLASS:	5	3	5	1,5
RAW MATERIAL:	4	2	1	2
WEIGHT:	0.2	0.6	0.5	0.3
MAXIMUM LENGTH:	13.3	15.5	10.0	12.7
MAXIMUM WIDTH:	9.1	14.6	3.7	2.3
POS. MAX WIDTH:				2.2
MAXIMUM THICKNESS:	2.1	2.7	3.7	2.3
POS. MAX. THICKNESS:				3.5
BLADE LENGTH:				8.6
STEM LENGTH:			5.7	4.1
BLADE WIDTH:				9.3
SHOULDER WIDTH:			11.6	9.3
POS. SHOULDER WIDTH:			6.1	2.9
NECK WIDTH:			10.3	7.2
POS. NECK:			4.8	3.1
STEM WIDTH:			12.3	6.8
BASE WIDTH:			11.0	6.6
BASAL NOTCH DEPTH:			0.5	
NOTCH 1 DEPTH:			1.0	
NOTCH 1 BREADTH:			2.1	
NOTCH 2 DEPTH:			0.9	
NOTCH 2 BREADTH:			2.8	
PROX.-LAT. EDGE 1 HT.			2.8	
PROX.-LAT. EDGE 2 HT.			2.3	
TIP ANGLE:				
BLADE ANGLE:				
EDGE 1 ANGLE:				65
EDGE 2 ANGLE:				60
INTEGRITY:	0	0	2	2
LONG. X SEC.:				2
TRANS. X SEC.:			1	2
BLANK TYPE:	3	3		
BLANK ORIENTATION:				
FLA KING TYPE OBVERSE:				5
FLA KING PATTERN OBVERSE:				1
FLA KING TYPE REVERSE:				5
FLAKING PATTERN REVERSE:				1
BLADE EDGE 1 SHAPE:				2
BLADE EDGE 1 MORPHOLOGY:				9
BLADE EDGE 2 SHAPE:				2
BLADE EDGE 2 MORPHOLOGY:				9
SHOULDER 1 SHAPE:			1	9
SHOULDER 2 SHAPE:			1	9
EDGE GRINDING:			6	9
BASE SHAPE:			3	2
BASAL THINNING:			3	5
NOTCH 1 SHAPE:			1	9
NOTCH 1 ORIENTATION:			1	9
NOTCH 2 SHAPE:			1	9
NOTCH 2 ORIENTATION:			1	9
NOTCHING TECHNIQUE:			1	9
PROX.-LAT EDGE 1:			1	9
PROX.-LAT EDGE 2:			1	9
TIP MORPHOLOGY:				9
WEAR TYPE:				
WEAR LOCATION:				
HEAT TREATMENT:				
FIGURE REFERENCE:	45.t	46.u	46.x	45.x

(* = Incomplete)

APPENDIX 4

FAUNAL ANALYSIS

METHODOLOGY

APPENDIX 4

FAUNAL ANALYSIS METHODOLOGY

LABORATORY TECHNIQUES

Laboratory techniques can be divided into three sections: 1) Method of Identification; 2) Cataloguing System; and 3) Data Base Management. The emphasis in the development of all of these systems was to accommodate the bison remains but this was seldom at the expense of the other species represented in the faunal assemblage.

Method of Identification

Identification of faunal remains took place at the Archaeological Survey of Alberta (ASA) building in Edmonton. We were extremely fortunate to have two well maintained comparative collections which represent the wide range of fauna from Alberta. The majority of remains were identified using the ASA collection but additional materials and helpful advice could be found at the University of Alberta's Anthropology Department. The faunal collection there complements the ASA's and any problems presented could be solved by their faunal expert, Ms. Jean Hourston-Wright.

Identification of bison remains was assisted by five complete comparative skeletons: a 7 year old male; a 4 year old cow; a yearling bull; a full term foetus and a 6 week foetus.

Identification was hampered by the fragmentary nature of the remains. Many fragments were very probably bison but lacked the necessary land marks needed to confirm a species level identification. The majority of these fragments could be classified only as large mammal. Other problem areas resulted from fragments which were either rib or the dorsal spine of the thoracic vertebrae. Many fragments were large enough to identify as one of these two types of elements but were too small to make the necessary distinction. These fragments again often ended up classified as large mammal.

As noted in the excavation section, two methods were used to try to preserve crumbling elements. The white glue technique worked well but bone wrapped in aluminum foil often fell apart before an element identification could be made. It should be noted that when bone from Head-Smashed-In falls apart, often all that is left is "bone dust and dirt". Refitting is utterly impossible.

Bison bone was identified to element and portion of element, if a fragment. This fragment identification was made on the basis of John Brumley's manuscript for ungulate identification (Brumley 1980). Brumley's method was conceived as an aid to analysis and identified fragments of elements resulting from butchering. The Head-Smashed-In group used the system as a method of identifying fragments only and it is not meant to infer butchering units in this context. If a fragment was not covered by Brumley's butchering units an arbitrary decision was made by the cataloguer as to which "butchering unit" was closest to representing the fragment.

Cataloguing System

The cataloguing system for Head-Smashed-In was designed to embody three major themes: 1) the catalogue system was meant to be purely descriptive and incorporate a catalogue number, provenience information, faunal identification ranging in taxonomic levels from class to species, element identification including a 'butchering unit', associations and alterations to the bone; 2) the majority of the assemblage consists of Bison remains so the emphasis in element and 'butchering unit' identification would centre around ungulates; 3) the data generated from the cataloguing system would become part of a computer manipulated data base management system therefore the information would be coded at the time of cataloguing.

A listing of the codes used can be found in the appendices. The codes used for element and 'butchering unit' identification were from Brumley's manuscript on ungulate identification. Additions were made to Brumley's system to include fragments which could not be identified to element but could be categorized as belonging to a certain type of bone. For example, a fragment may have been ascribed to a long bone but no identification could be made as to which long bone. It was also necessary to include new codes for teeth. These additions to Brumley's system are found in the appendices.

The ungulate coding system was flexible enough to allow coding of any mammal encountered in the Head-Smashed-In faunal assemblage. Example of birds and fish were exceedingly rare, therefore no special codes were created to incorporate them.

An effort was made to identify each piece to the species level and to assign an element and 'butchering unit'. Each piece was examined for butchering marks and alterations. Where a successful identification was made to the species/butchering unit level, the element/fragment was bagged with a tag including all provenience information and the code for the element. Fragments which shared a more general level of bone classification and the identical provenience information were lot/bulk bagged, tagged in the same manner and weighed. No fragment counts were taken. Non-bison bones were flagged by a species or the applicable higher level code and kept separate from the remainder of the assemblage.

Data Base Management

The data base management system (DBMS) software chosen was SPIRES (Stanford Public Information Retrieval System) which was run on the University of Alberta computer system using the MTS (Michigan Terminal System) operating system.

Efficient adaptation of SPIRES to archaeological data requires a tailored file definition. Batch loading of data (loading more than one record at a time) requires a custom input format to read the file containing the raw data and load this file in the SPIRES.

Field Label	Codes
Catalogue Number	
Area:	Codes used = Area number: 1, 2, 11, 12
Unit:	Codes used = Unit number: Excavation units 1-500; Shovel tests 501-700; Auger tests 701-900; Backhoe tests 901-998; Surface finds 999
Quadrant:	Codes used = Quad number: Quads = 1, 2, 3, or 4; No quad specified = 0; No quad applicable = 0
Subquadrant:	Same as Quadrant
Position North:	Codes used = position in centimetres (up to three digits)
Position West:	Same as Position North
Level:	Codes used = Level
Depth:	Codes used = depth in centimetres (up to three digits)
Subfile:	Codes used - 2 (Faunal)
Category:	Codes used = 1 single bone; 2 Multiple pieces of a single bone; 3 lot/bulk bag.
Class:	Codes Used: 01 Mammal 02 Avies 03 Reptiles 04 fish 05 Amphibian 06 Mollusc 07 Insects 98 Undetermined 99 Indeterminate
Order:	Codes used: 01 Artiodactyla 02 Rodentia 03 Carnivoria 98 Undetermined 99 Indeterminate
Family	Codes used: 01 Bovidae 02 Cervidae 99 Unknown
Genus	Codes used: 01 Bison 02 Bos 03 Ovis 99 Unknown

Field Label	Codes
Species:	Codes used: 01 Bison bison 02 Bison 99 Unknown
Size:	Codes Used: 01 Large 02 small 99 Unknown
Section:	Codes used are Brumley's codes for bison elements. Additional codes used: 60 long bone fragment 62 epiphysis 63 costal cartilage 64 scapular cartilate 65 skull fragment 66 tooth fragment 67 upper tooth 68 incisor/canine 69 lower molar/premolar 70 rib fragment 71 vertebral fragment 72 intervertebral disc 99 unknown
Butchering Units	Codes used are Brumley's Butchering Units for bison element fragments
Side:	Codes used: 1 Right 2 Left 3 Axial 9 Unknown
Number:	Codes used: 01-13 According to number of element. 98 Does not apply 99 Unknown
Associations:	Codes used: 1 No known association with other specimens 2 found articulated with another specimen 3 fragment can be refitted to another specimen 4 discrete concentration
Alterations:	Codes used: 1 no significant alterations observed 2 incisions 3 surface reduction 4 thermal 5 combination of above

1. Final Report of the 1983 Season at Head-Smashed-In Buffalo Jump, Alberta. By J. Brink, M. Wright, B. Dawe and D. Glaum. 373 pp. 1985.

2. FjPi-29, A Prehistoric Workshop Site in the Alberta Parklands. By B. Newton and J.W. Pollock. 119 pp. 1985 (Bound with No. 3 and No. 4).

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